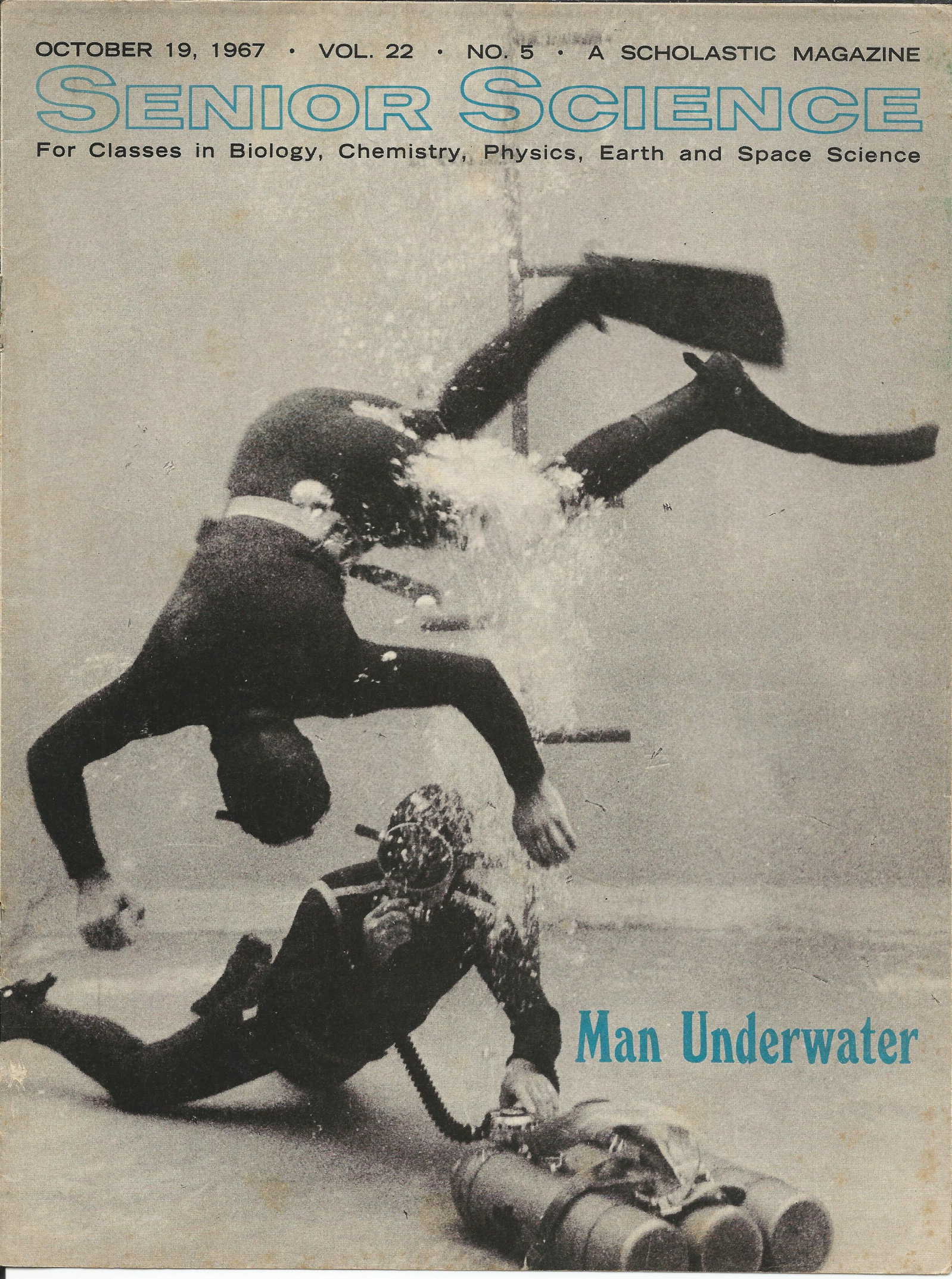
OCTOBER 19, 1967 • VOL. 22 • NO. 5 • A SCHOLASTIC MAGAZINE

SENIOR SCIENCE

For Classes in Biology, Chemistry, Physics, Earth and Space Science



Man Underwater

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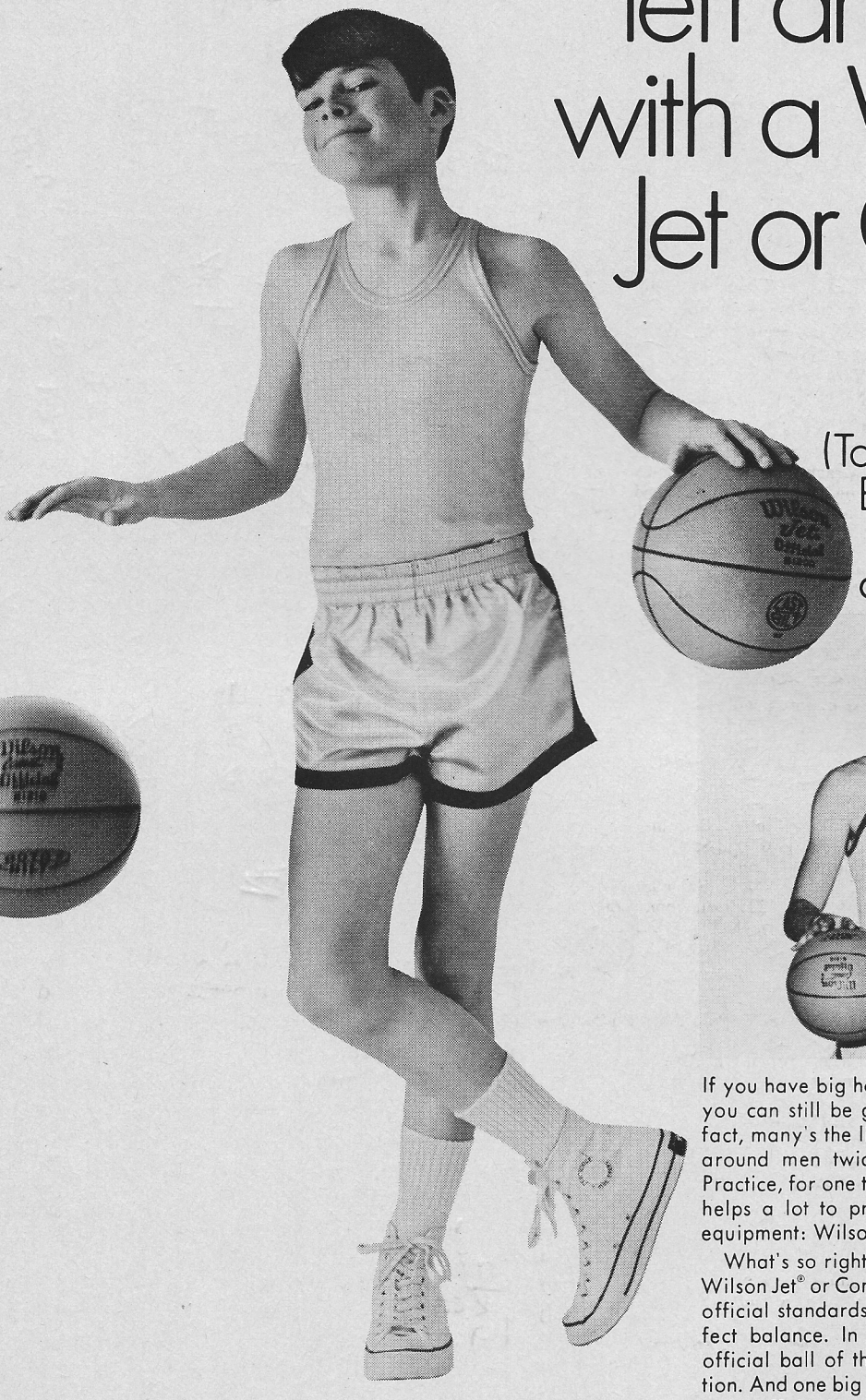
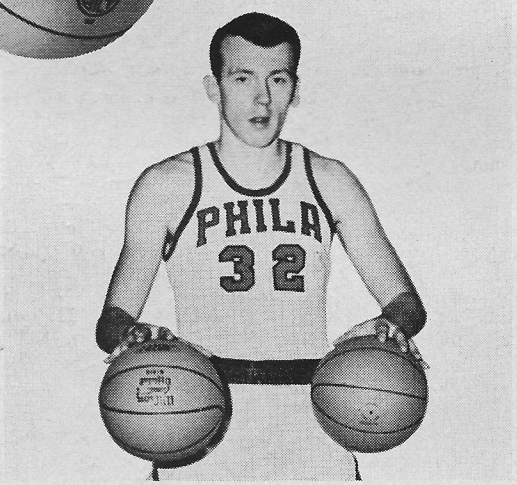


(Take it from Billy Cunningham* about their great control-ability.)



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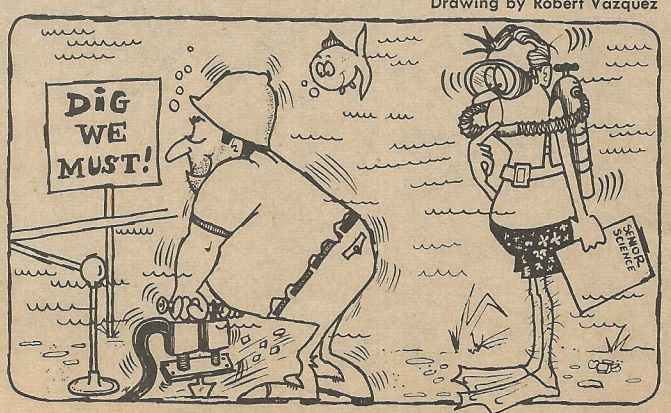
Cover photo: *Three Lions*

Our Front Cover

The three young men on our cover are not diving for anything, or rescuing anyone, or exploring the ocean floor. But they are being trained to do all these things. They're going to a French school for frogmen. All over the world, men and women are preparing to invade a strange and hostile underwater world. For the reasons why, read the article beginning on page 2.

Drawing by Robert Vazquez



Man
Under
the
Sea

Tomorrow may see communities established on the continental shelves of the continents. Living on the ocean floor, man will tap rich resources.

PICTURE a glowing city 450 feet beneath the surface of the sea. The city is lit by powerful lamps that roll back the perpetual midnight of the deep. Its aquanaut inhabitants live in pressurized glass domes. Inside the domes, temperatures are a tropical 85°F, and the air is under a pressure of about 220 pounds per square inch – or 15 times that at sea level (14.7 pounds per square inch).

While swimming outside their dwellings, some aquanauts breathe with the aid of the SCUBA (Self-Contained Underwater Breathing Apparatus). The SCUBA tanks contain compressed mixtures of the gases oxygen and neon. But many of the aquanauts don't breathe gases: Their lungs are filled with oxygen-enriched salt water and function as gills – they are human fish!

The aquanauts have an impressive array of equipment: closed-circuit, computerized television, which scans the ocean bottom; submarines with automated arms and hands that operate screwdrivers and jackhammers; advanced navigation and communications systems; instruments whose dials can be read by the Braille method in total darkness.

These aquanauts of tomorrow have a mission: the exploitation, for the benefit of the world above the waves, of vast resources that today lie untapped in the continental shelves.

Whether this is science fantasy or tomorrow's reality will be determined by research now underway at laboratories around the world.

In the sea, as in space, man is a frail, if adventurous, alien. Atttempts to put man in the sea are older than yesterday. As early as 1788, a British engineer, John Smeaton, designed a machine that used "force pumps," or bellows, to push vital air through a tube to a diver under water. From Smeaton's start came today's caissons, diving bells, and the traditional portholed, watertight helmet worn by divers around the world.

But such devices have limits that are set by the human body. As you know, the deeper a diver descends, the greater becomes the weight, and hence the pressure, of overlying water. In fact, pressure increases by an atmosphere, or 14.7 pounds per square inch (p.s.i.), with every 33 feet of descent. At 400 feet, for instance, there is a vise-like force of about 200 p.s.i. pressing against the diver from all sides. Thus, if the diver is to take a breath, the air (or other breathing mixture) must be supplied to him at roughly equivalent pressures. Otherwise, he would never be able to expand his lungs against the great force of the "iron maiden" of the sea.

But oxygen, under pressure, has a poisonous effect on the human nervous system. Tests show that pure oxygen cannot be breathed at pressures greater than 1.8 atmospheres – below a depth of about 25 feet.

At depths greater than this, oxygen must be supplied as an increasingly smaller part of a mixture including other gases. You know, of course, that the air we breathe is actually just such a mixture – roughly one-fifth oxygen. Why not, then, merely pump *air* under pressure to deep-sea divers?

The answer is that the nitrogen in air has toxic, or poisonous, effects on man under pressure. Pressurized nitrogen "dopes up" the nervous system. It acts as a narcotic. Deep sea divers refer to *nitrogen narcosis* as "the rapture of the depths." Nitrogen gas makes up approximately 79 per cent of the air we breathe on planet Earth. But a diver breathing this much nitrogen at a depth of 150 feet becomes as useless as a thoroughly intoxicated man!

Researchers have found that nitrogen narcosis can be eliminated. How? By the substitution for nitrogen of an *inert* (chemically inactive) gas, such as *helium*, in the diver's breathing mixture. Although inert helium produces no narcosis, it creates a different kind of problem. It garbles voice communications!

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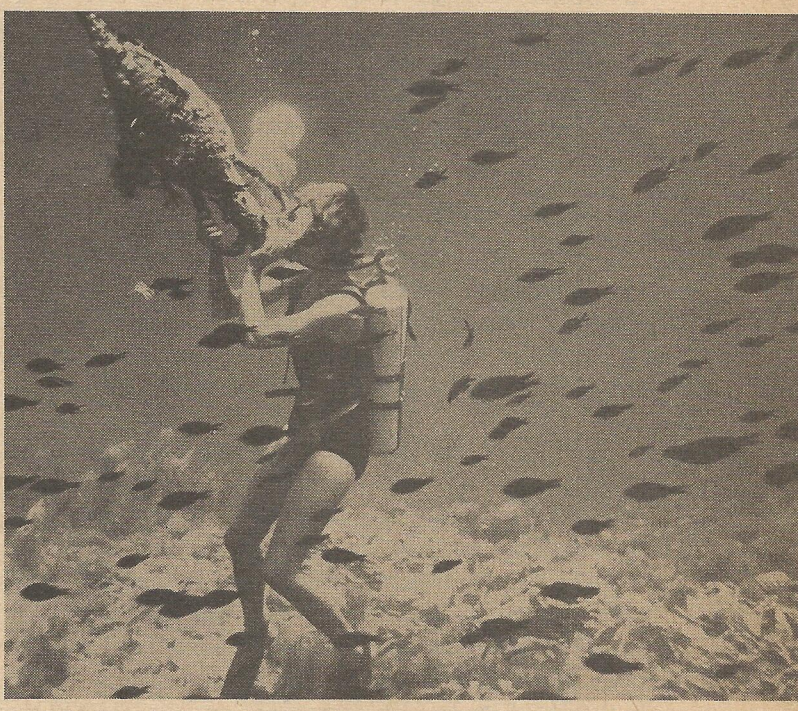
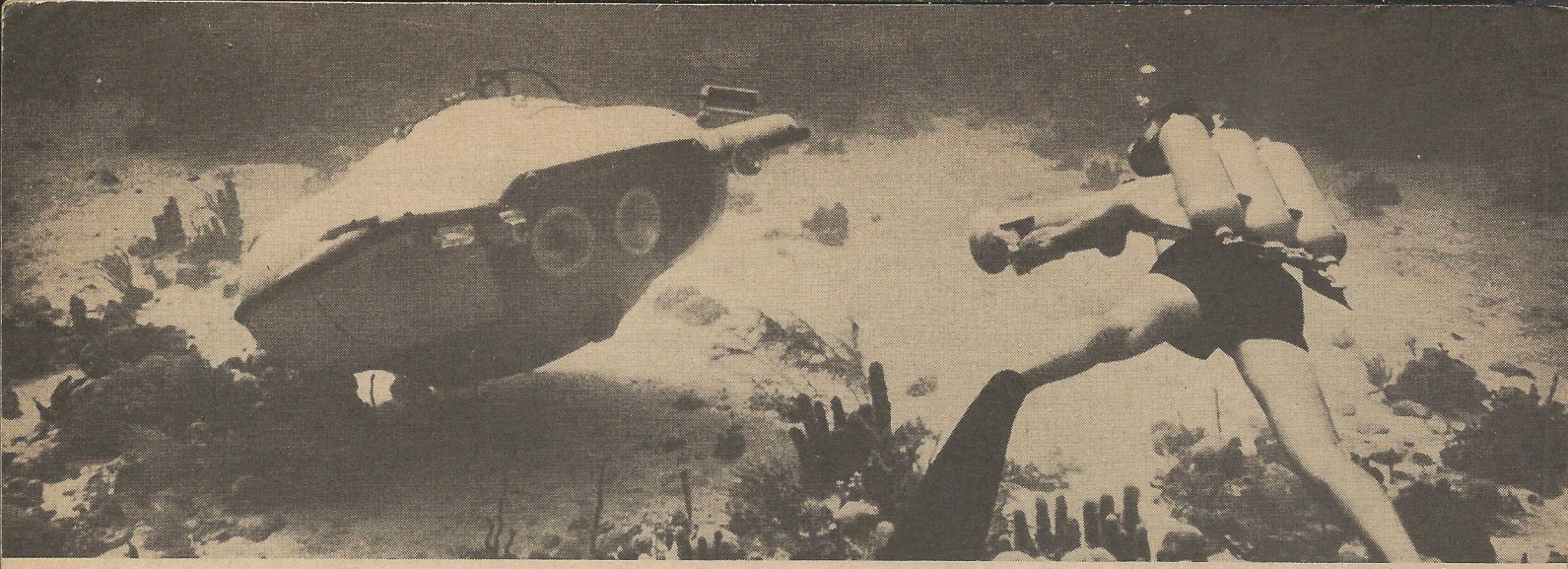


Aquanauts of the U. S. Sea Lab II project hold an underwater meeting. Team lived a month under the Pacific Ocean in 1965.
Flip Schulke from Life Magazine

Aquanaut-archeologist injects air from SCUBA tank into Roman urn found on ocean floor off Turkey. Urn will float to surface.
Turkish Government Information Office



Westinghouse Photo

Pioneer underwater exploration vehicle Deepstar **was designed by French aquanaut J. Y. Cousteau to reach depths of 1,000 ft.**

Man Under the Sea *continued*

Why? The familiar qualities of human speech depend on the properties of the medium through which sound waves are normally propagated – that is, on the physical properties of air. Change the medium, and you change the quality of the human voice as well.

When sound waves are propagated through helium, the human voice resembles a speeded-up recording of Donald Duck. But voice communications will be essential to men living under the sea. Researchers worried: What could be done to overcome the distortions in speech introduced by helium gas?

One of the leading organizations engaged in undersea research is Ocean Systems, Inc., of Tonawanda, N. Y. At Ocean Systems, researchers tried substituting the inert gas neon for helium in pressurized breathing mixtures. They put men into a largely neon atmosphere at pressures up to 16.4 atmospheres, equal to pressures found at 650 feet – the lower limits of the continental shelves.

Beating the Bends

Results? According to Ocean Systems research supervisor Dr. Heinz R. Schreiner: ". . . a mixture composed largely of neon improved the diver's voice quality to full intelligibility. The high-pitched metallic voice quality associated with helium speech remained notable, however."

"Rapture of the depths" and communications problems may give way to tomorrow's neon-oxygen breathing mixtures, but an old and deadly enemy of the deep-sea diver will not be so easily defeated: the *bends.*

What are the bends? At atmospheric pressure, gases such as neon, helium,and nitrogen will not dissolve and enter the blood stream. But, when introduced into the body under great pressure, they are forced into solution in the blood stream. Unless precautions are taken during the ascent to the surface, these dissolved gases will bubble rapidly out of solution as pressure decreases. The result is the blocking of capillaries – causing divers to suffer paralysis, extreme pain, and, sometimes, death.

How to avoid the bends? Two methods are widely used today. Gradual decompression, in small, controlled steps, prevents the sudden release of capillary-obstructing gas bubbles from solution. Thus one approach is for the diver's ascent to be carried out very slowly. Or, he may be pulled quickly to the surface in a pressurized "elevator" (such as the Link Cylinder designed by American engineer Edward A. Link in 1956) to undergo a long decompression period in a special chamber on the deck of his support ship.

But all the diving techniques described so far are child's play compared to a new approach that has made possible much longer stays under the waves. In 1965, French scientist J. Y. Cousteau took a team of aquanauts to a depth of 330 feet beneath the Mediterranean Sea. They stayed down for *three weeks!* In the same year, the United States countered. Spaceman-turned-aquanaut Scott Carpenter headed up an American group that lived a *full month* 210 feet beneath the Pacific in an underwater habitat known as Sea Lab II!

The secret of these long-duration underwater successes is a new technique called *saturation diving.* Former Navy Commander Arthur J. Coyle, one of the

U. S. Navy frogman pauses to "chow down" from squeeze bottle during test dive. Squeeze bottle contains a nutrient paste.

Wide World

marine engineers who worked on Sea Lab II in the U. S. Man-in-the-Sea Program, describes it this way: "In the saturated technique, a diver's body fluids and tissues are intentionally *saturated* with the breathing mixture. In 200 feet of water, for example, saturation requires about 24 hours. A person can work from four to eight hours a day for periods in excess of a month without increasing his required decompression time."

To date, the longest dive at the deepest depth has been made by Ocean Systems aquanauts Robert Stenuit and Jon Lindbergh. In July, 1964, they went down in a pressurized Link Cylinder to a depth of 432 feet beneath the Atlantic Ocean near Berry Islands, the Bahamas.

Once they touched bottom, the aquanauts left the cylinder by means of special hatches and swam to a rubber tent anchored on the ocean floor. Stenuit recalls, "We used the tent as our base for two days and nights, swimming out freely to work in the surrounding water for many hours." The record-holders' tissues were saturated with a mixture of gases consisting of 4 per cent oxygen, 5 per cent nitrogen, and 91 per cent helium. On returning to their support ship, the aquanauts spent *four days* in a decompression chamber. Finally, they emerged into atmospheric pressure at sea level, never having suffered even a twinge of the bends! No one before or since has stayed so long at so great a depth. But these men proved it can be done.

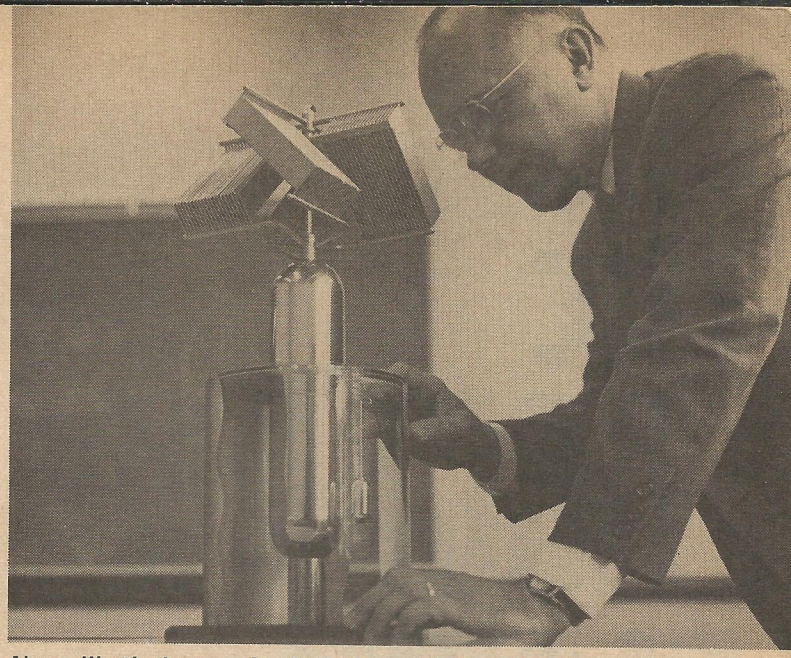
Men with "Gills"?

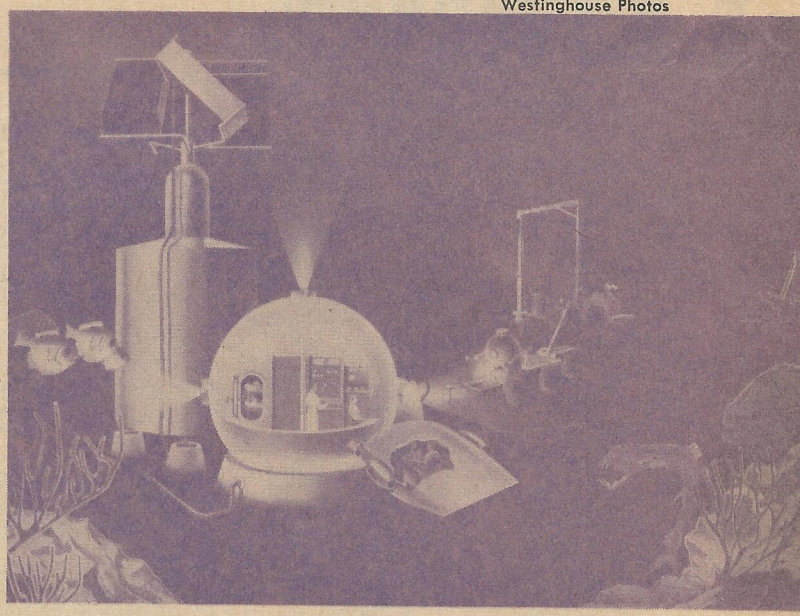
Stenuit believes that tomorrow's breakthroughs may write an end to the weariness of long decompression periods. Recent experiments with rats suggest that certain new drugs, injected into the body, may eventually allow divers to breathe pure oxygen mixtures under pressure, with no poisonous effects. If so, there will be no need for helium, nitrogen, neon, or other gases that cause bends. Or it just may be that tomorrow's cure for "decompression blues" may be to sidestep the gas-mixture problem entirely.

How? Recently, Dutch biologist Johannes Kylstra immersed dogs in a solution of salt water saturated with oxygen. For more than 45 minutes, the dogs took the oxygen-rich solution into their lungs. Did they drown? No! The oxygen from the solution was directly absorbed by the blood vessels of the animals' lungs. In short, their lungs functioned as gills! Today, the dogs are back to breathing air – and show no adverse effects from their masquerade as fish!

Man, researchers believe, may be physically capable of duplicating the trick performed by the dogs. If so, the bends would be laid to rest at last, and man could descend as far into the high-pressure depths as the strength of his skeleton and muscles permitted.

But the problems to be overcome are many. Among them: the near-freezing temperatures of the inky deep. A frogman's foam-rubber wetsuit provides sufficient cold insulation near the surface. In the depths, however, pressure compresses the foam, and a suit becomes as ineffective in keeping out cold as a thin rubber glove. Advanced suits are on designers' drawing boards. (So far, those that are electrically heated have proved too cumbersome for easy use.)





Above: Westinghouse scientist R. C. Cunningham inspects model of nuclear power plant capable of withstanding pressure two miles under the sea. "Paddles" at top radiate heat and keep unit cool. Below: Artist's conception of the working unit.

Westinghouse Photos

New bioinstrumentation may be needed to warn aquanauts of approaching internal danger. One such instrument was recently announced by Dr. Sabbo Woldring, of the Roswell Park Memorial Institute, Buffalo, N. Y. It could monitor the pressures of various gases in the bloodstream and chirp a warning signal if danger levels neared!

Reliable underwater lights, better automated tools, new communication and navigation systems – these needs, too, must be met before tomorrow's aquanauts can be at home in the dark, cold reaches of the seas.

— JOHN SPEICHER

THE ACCIDENT PLAGUE

WHAT DISEASE kills most young people in this country?

Cancer? Pneumonia? Tuberculosis?

Actually, none of them. Most deaths of people between the ages of one and twenty-four are caused by accidents.

"But," you may protest, "that's not a disease." And, as the word is commonly understood, you're right. One broad definition of a disease, however, is anything that impairs health. And, from this viewpoint, the rising rate of accidents is a major public health problem – a spreading plague as deadly as typhus, yellow fever, malaria, or the "black death" itself.

Medical advances have tamed most serious infectious diseases in the world's developed countries. Particularly, the traditional killers of youth – poliomyelitis, tuberculosis, diphtheria, pneumonia, scarlet fever, meningitis – are on the way out.

CBS News

But another killer is taking their place. The accidental death rate is rapidly increasing. And youth is the major victim. More than a third of the 113,000 people killed in accidents in the United States last year were under twenty-four.

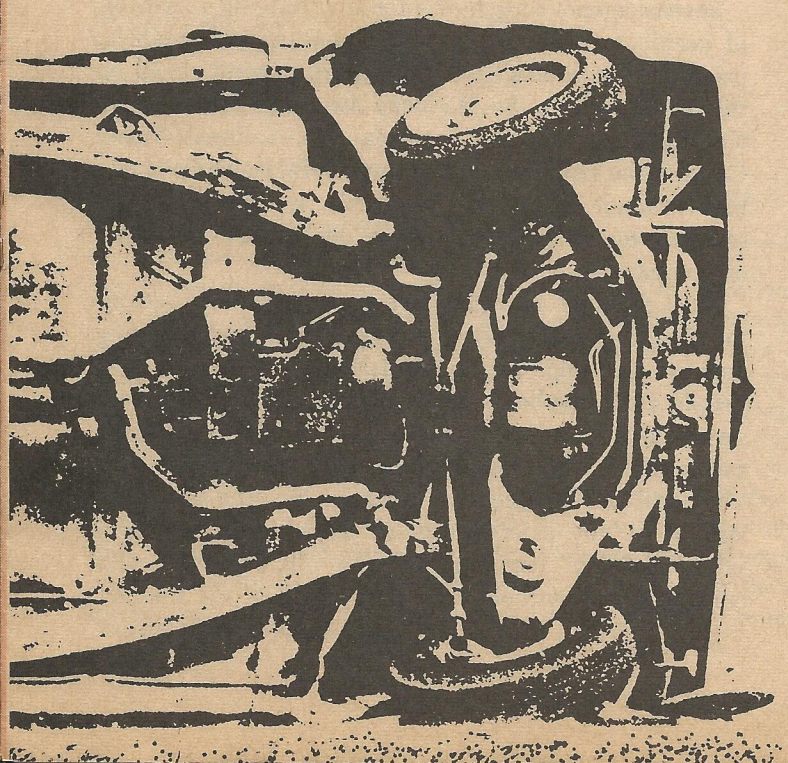
Most of these young people died in road traffic accidents. A large number were victims of drowning and boating accidents. Fire took a heavy toll, especially among tenement-dwellers. And accidental poisoning and suffocation were rough on the pre-school and kindergarten sets.

How can we stop this spreading "plague"? There are no serums to immunize people against accidents. Safety engineers and scientists insist, however, that this disease can be curbed by a two-pronged attack: better safety engineering based on research into accident causes, and more effective information and education programs.

The task, however, isn't an easy one. Accident causes are sometimes obvious, but, more often, they're complex and hidden.

Even when the causes are obvious and the necessary preventive measures are simple and straightforward, accidents still happen. Accidental poisoning of children is a good example. Such accidents usually result from medicines and household cleansers being left within the reach of curious tots. Simple preventive steps involve little more than locking up such items. Yet, nearly half a million children were accidentally poisoned in this country last year. And more than 800 children and young people died from these accidents. (These figures don't include food poisonings, which are not considered as accidents.)

What can be done? Inform and educate the parents; this is probably the only answer. Vigorous information campaigns do work: They've been quite effective in helping reduce industrial accidents.



Fire is another obvious danger to children that must be stressed in parent-education programs. The American Medical Association recently pointed out that most of the more than 2,000 children who died in home fires last year could have saved themselves if they'd been given some simple fire instructions.

Parents, who would be horrified if the schools didn't have fire drills, don't even discuss the chances of fire at home. As a result, instead of escaping as soon as a fire starts, some children try to put it out (especially if they've started it). Others search for parents, or wait to be told what to do. Many children try to save toys and pets. Whatever the reason, needless delay too often leads to tragedy — death or injury that could have been prevented by a few words of previous instruction.

Effective information lessens the likelihood of all types of accidents. However, more than words are needed to curb the biggest killer — road traffic accidents. Part of the problem is that it's difficult to pinpoint the causes.

Why do we have so many traffic accidents? The answers depend on who's being asked. "Bad drivers" say the police. And they're partly right. They see them all — careless drivers, speeding drivers, selfish drivers, sleepy drivers, sick drivers, inexperienced drivers, arrogant drivers, drunken drivers, angry drivers . . . and so on.

But "bad" drivers can't be the only cause. After examining a number of 1965's serious traffic accidents, the National Safety Council found that four out of five of the drivers involved had no previous accident records, nor did they have histories of traffic violations.

"Good" — alert, courteous, experienced — drivers also have accidents. Why? Readers of Ralph Nader's book *Unsafe At Any Speed* may blame automobile design. Human-factors engineers tend to blame traffic signs, road design, and traffic patterns in general. And almost everyone blames bad weather.

Certain psychiatrists claim that the secret causes of some accidents are people's hidden desires to die or to kill. As Dr. Karl Menninger put it, "There is a little murder and a little suicide dwelling in every man's heart."

Safety experts don't agree that such hidden urges cause many accidents. In their opinion, man's natural instinct for survival offsets these desires, which gain the upper hand only during sieges of extreme anger or depression. In that case, anger and severe depression should be added to a safety campaign's "don't drive" list, which normally urges people not to drive when they're sick, tired, or have been drinking.

Many people believe that increasing congestion is a major contributor to the rising accident rate. But is it?

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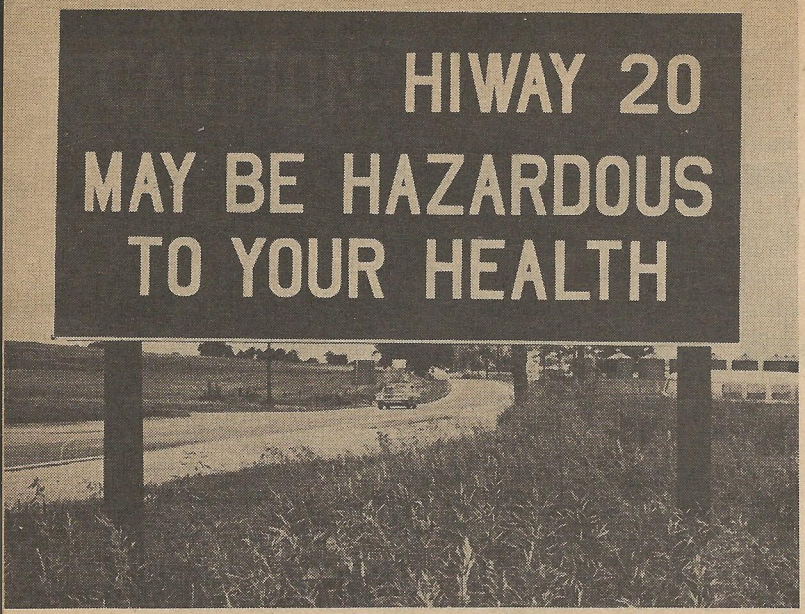


UPI

Illinois townspeople put up signs like this along 55 dangerous miles of U.S. 20 in bid to get new highway with safer design.

Henry Groskinsky, Life Magazine (c) Time, Inc.

Auto safety engineer adjusts dummy for test of injury resulting from impact. Research contributes to safer auto design.

Many lives are needlessly lost each year in home fires such as this one. Home "fire drills" are worthwhile preventive.

Stephen Douthat, Winner Eastman Kodak — Scholastic Magazine Photo Award

The Accident Plague *continued*

Last year's accident statistics suggest that perhaps it may not be. Relatively uncrowded Mississippi (46.1 inhabitants per square mile) had 8.7 traffic deaths for each ten thousand motor vehicles — the nation's highest rate. On the other hand, crowded Rhode Island (812.4 inhabitants per square mile) had the lowest rate — 2.6 traffic deaths for each ten thousand motor vehicles. And this pattern holds true across the nation: States with wide open spaces and few people — New Mexico, Arizona, Louisiana, and Nevada — had high traffic fatality rates, whereas congested Connecticut, New Jersey, and Massachusetts were on the low end of the scale.

It would seem that there are no clear-cut answers to the question of what causes traffic accidents. Every factor that we've mentioned, and several that we haven't, play a part. But what part? That's a crucial question!

Many present preventive measures don't work very well, because some accident-causing factors are overemphasized, while others are overlooked. For instance, speed has been considered one of the chief accident-causing "demons." Therefore, much effort has been spent in setting and enforcing speed limits. But the speed limits often don't make sense; they're frequently violated, and truly effective enforcement is impossible.

Speed does play a part in accidents. But you can't set a "safe" speed limit for all occasions. The limit should really vary with road conditions, weather conditions, time of day, condition of the motor vehicle and mood of the driver. In effect, each driver must set his own speed limit for the conditions under which he is driving; this might often be much lower than the posted speed limit. While speed has been getting most of the blame, hazards such as poor road design, bad illumination, and roadside obstructions have been largely ignored.

Several agencies are now intensely studying all aspects of accident causes in order to come up with realistic preventive measures. Groups that are moving ahead on this effort include the Highway Research Board of the National Academy of Sciences, the National Safety Council, the Division of Environmental Health Sciences, the National Bureau of Standards, several university research teams, many insurance companies, and some oil companies.

Most of these agencies have one preliminary recommendation — involve the public in road safety planning and campaigning. Traffic regulations fail because most people don't like being told what to do. But if they are involved in and concerned with the problem of traffic safety, they will regulate their own driving conduct. They will also be receptive to advice. So, in a sense, the success of any safety program depends on having a safety-conscious community. After all, a doctor can't cure a disease without the cooperation of the patient.

— Samuel F. O'Gorman

Fireworks get their sparkle and bang from the explosive qualities of compounds containing sodium (Na) and potassium (K).
UPI photo

Na & K— The Alkali Twins

ASK your friends to name the metal elements, and they will undoubtedly say iron, lead, silver, zinc, aluminum, gold, copper . . . and so on. But, unless they've read this article, they probably won't mention *sodium* and *potassium*. Yet these two elements are not only metals, but in pure form they will probably have a profound effect on our future.

Electric cars of tomorrow will be driven by sodium

Continued on next page

batteries. And right now, sodium-potassium metal alloys, in liquid form, are opening up a new area of chemistry that promises hundreds of new materials. (An alloy is a mixture of two metals whose orderly arrays of atoms can fit together without any actual chemical combination.) Sodium, potassium, and sodium-potassium alloys are finding ever-increasing use in cooling atomic reactors, triggering chemical reactions, and purifying air.

Sodium (Na) and potassium (K) are, paradoxically, both plentiful and scarce at the same time. They are our fourth and fifth most abundant metals — forming 2.64 per cent and 2.40 per cent, respectively, of the Earth's crust. Yet you couldn't gather, from natural sources, even a chunk of either one.

Why? Although they're plentiful in chemical combinations *(compounds)* with other elements, sodium and potassium are never found alone in a natural state.

The reason? They're members of the *alkali metals family.* Chemically speaking, metal elements differ from nonmetals in that the metals have a tendency to lose electrons. Some metals have this tendency more than others. And alkali metals have it most of all.

As you know, an atom consists of a nucleus — of neutrons and protons — orbited by electrons. The negatively charged electrons are electrically attracted to the positively charged nucleus. But this attraction decreases with distance from the nucleus.

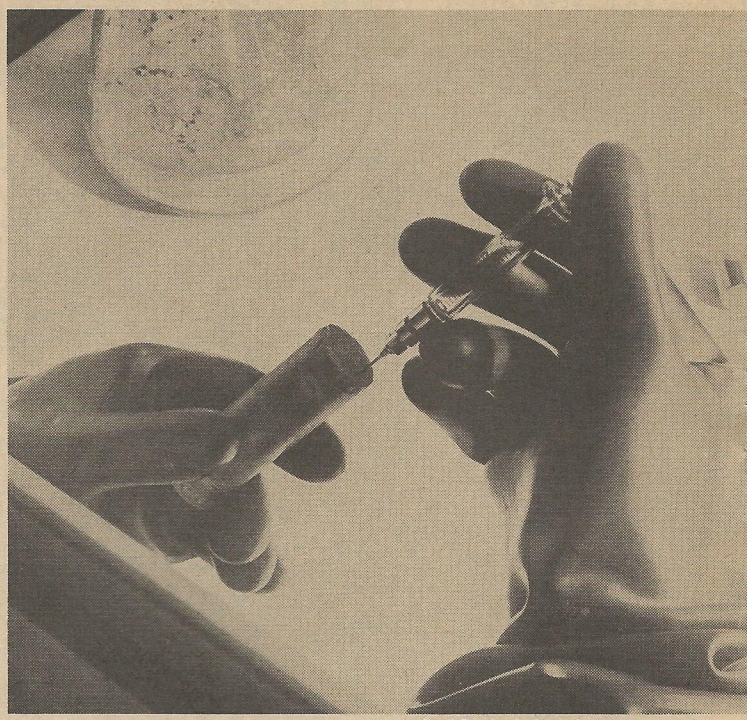
Isolating Atoms

Metal atoms are relatively larger in diameter than nonmetal atoms. And as a result, their outer electron shells are less tightly bound to the nuclei. Since most metals have few electrons in their outer shells, these are easily lost. Thus, while nonmetals tend to gain electrons in a chemical reaction, metals tend to lose them. An atom that has lost an electron is known as a *positive ion* because it has lost a negative charge. And an atom that has gained an electron is called a *negative ion.*

Alkali metals are characterized by having single electrons in their outer atomic shells. And, since they're out there all alone, these electrons are very easily lost to neighboring atoms. Result: chemical combinations. It is because of this that alkali metals don't exist pure in nature, but are found only in compounds.

However, their very *reactive nature* (ability to cause chemical change) makes them particularly useful as change-producing *chemical agents.*

The alkali metals are lithium (Li, atomic number 3), sodium (Na, 11), potassium (K, 19), rubidium (Rb, 37), cesium (Cs, 55), and francium (Fr, 87). Even in compounds, sodium and potassium are the only really plentiful ones. Francium has never actually been seen. It's a short-lived product of the disintegration of actinium, and it is identifiable only by its radiation.



Carl Byoir & Associates, Inc.

Alkali metals must be handled with extreme care, as this picture of liquid cesium being extracted from a vial shows.

Sodium and potassium were the first of the alkali metals to be discovered. In 1807, Sir Humphry Davy *electrolytically* separated (produced a reaction by passing an electric current through the substances) the compounds lye (sodium hydroxide, NaOH) and caustic potash (potassium hydroxide, KOH) into their respective elements, thus isolating sodium and potassium.

Later experimenters found that, to keep the isolated metals from combining with the oxygen in the air or with almost any other element around, they had to be wrapped in a blanket of one of the unreactive gases. (The unreactive gas elements — helium, neon, argon, krypton, xenon, and radon — will almost never form compounds with other elements, because their outer shells are completely filled with electrons.) The difficulty in handling pure sodium and potassium limited their use for a long time afterward.

However, long before Sir Humphry's discovery, various compounds containing sodium and potassium were known, used, and became extremely important to mankind. They still are.

Table salt, a compound of sodium and chlorine (sodium chloride, NaCl), is a necessary part of our diet. All animal life requires quantities of sodium. Another sodium compound, lye (sodium hydroxide, NaOH), is essential for the manufacture of soap, leather, rayon and other textiles, paper, several food products, and many petroleum products.

Although some potassium compounds have tradition-

ally been used for their destructive powers, others are helping feed the world's ever-growing population.

Man's oldest explosive, gunpowder, contains a large proportion of saltpeter (potassium nitrate). And another potassium compound, potassium superoxide, is a more powerful explosive. The real promise of potassium compounds, however, is not in their explosive qualities, but in their ability to nourish plants, and thereby give us more food.

Potassium is one of the essential nutrients for plant growth; it is often in short supply in some soils. Various types of potash (potassium chloride, potassium sulfate, and potassium carbonate) satisfy this need. Not only do plants need potassium to flourish; we do, too. We obtain it in our food, particularly in raisins, beans, and bananas.

Sodium-Powered Cars

Despite our physiological needs for sodium and potassium, you wouldn't want to swallow either one in its pure state. For these are very dangerous metals. They will combine with almost any substance they touch. When exposed to air, they combine rapidly with oxygen – burn up. Potassium, which is the more reactive because its atoms are larger, may combine with explosive force.

In recent years, improved methods of processing, packaging, and handling these difficult metals have been developed. And now their violent natures are being put to many uses.

Sodium may help fuel the cars of tomorrow. Ford Motor Company's Scientific Research Staff has developed a sodium-sulfur storage battery that can store 15 times more electrical energy than present lead-acid batteries. In fact, this battery can supply more electrical energy than any other existing type, including the expensive space-age silver-zinc batteries. This is the breakthrough that may make electric cars practical and economical.

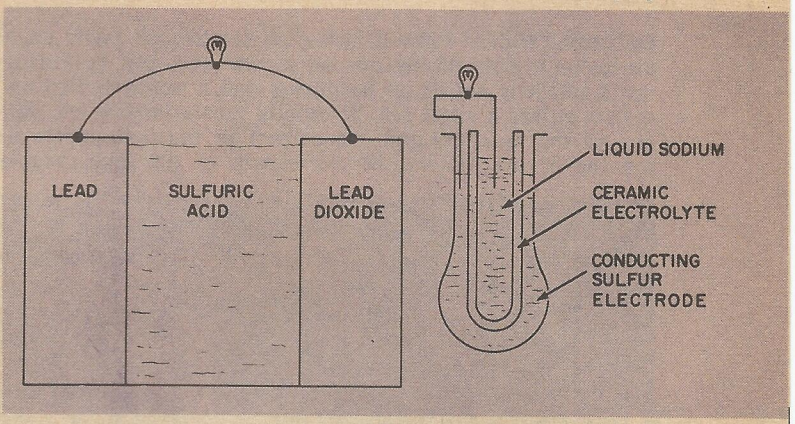
The new Ford battery contains liquid sodium and liquid sulfur, separated by a special ceramic material. Electrons move from the sodium electrode (electric source) to the sulfur electrode through an external circuit, thus constituting an energy source. This energy, when converted to mechanical energy, propels the car. Sodium is so reactive that it provides a freer flow of electrons than any previously used battery material.

Recently, Michael Ference, Jr., Ford's Vice President for Scientific Research, made this prediction: "While still in the early stages of development, our new battery system promises to meet one of the needs of an efficient, low-cost, compact, urban-suburban vehicle requiring only overnight recharging.

"Eventual use of such vehicles, possibly within the next decade, would help alleviate the problems of both congestion and air pollution in some metropolitan areas."

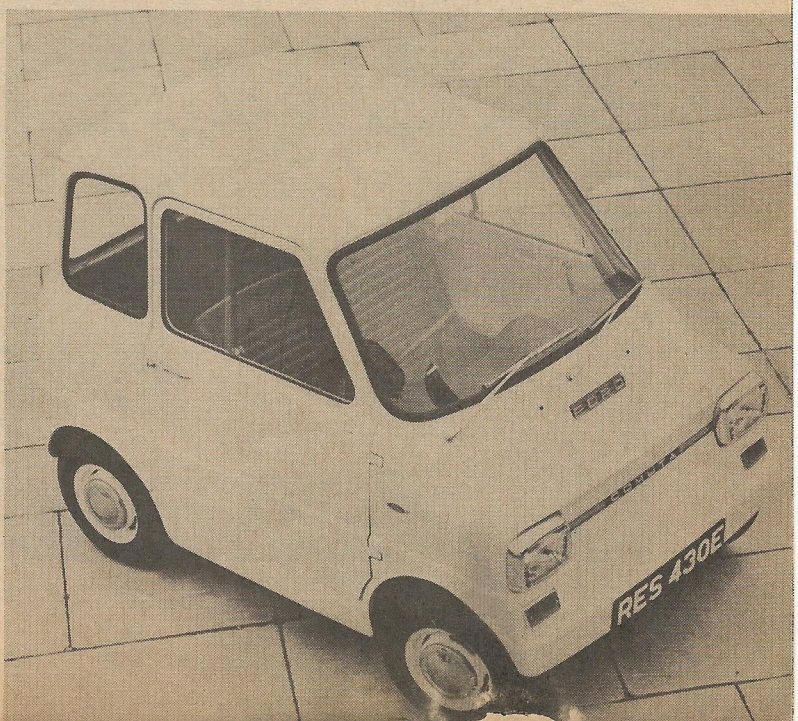
— Michael Cusack

Dr. Neil Weber (left) and Dr. Joseph Kummer of the Ford Motor Company examine an operating cell of the new sodium-sulfur battery. Ford Motor Company



In a conventional lead-acid battery (left) the lead and lead dioxide electrodes and the acid electrolyte **are chemically changed while energy is tapped. In the sodium battery, the current is carried by sodium atoms that cross over the ceramic electrolyte, leaving it unchanged.**

Electric cars, like this experimental Ford Comuta, may provide transportation without exhaust fumes in tomorrow's cities.



SCIENCE IN THE

Foam Fuel Lining

A new military secret looks like an orange sponge. A deadly weapon? No. It's simply a foam fuel-tank lining. But it eliminates explosions when a plane crashes or is hit by a bullet.

Air Force officials showed off the new plastic material recently at Wright-Patterson Air Force Base. They fired a bullet into an aircraft fuel tank loaded with jet fuel. The tank exploded. A second bullet ploughed into a full tank lined with the new foam. A slight glow followed as the fuel that dribbled through the bullet hole ignited. But there was no explosion.

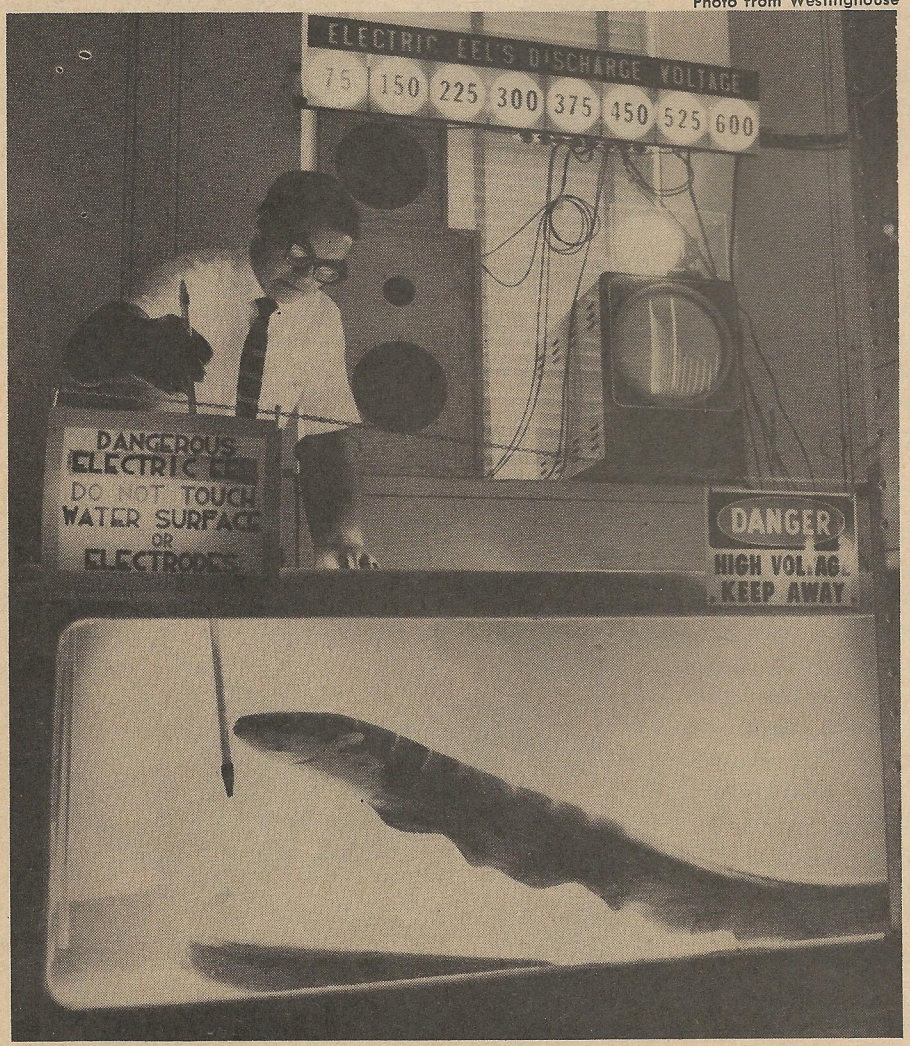
The orange synthetic is stuffed into the fuel tanks so that it covers the space inside. It only slightly reduces the capacity of the tank, because the fuel flows through the foam.

Air Force officials say that the foam has been used in Vietnam for about nine months. The only aircraft they would specifically identify as using the material is the "Jolly Green Giant," the helicopter used in rescuing downed pilots.

The Federal Aviation Agency is looking into the possibility of using the orange foam in the fuel tanks of commercial planes, or even in automobiles. The foam was originally used in the tanks of racing cars.

Eel-Ectric! With a 600-volt strike, an electric eel lights up his own tank and takes his picture! Eel-ectricity opened a new aqua-zoo in Pittsburgh. An impulse from the 5-foot long eel lit up floodlights and a welcome sign on opening night. Below, the eel strikes a metal rod. Electricity shoots through the water. Electrodes at either end of the tank transmit the current to the instruments and the flash lamps at the top of the picture. At the bottom of the tank, another eel waits to strike.

Photo from Westinghouse



Finders-Keepers?

Trillions and even quadrillions of tons of gold, copper, uranium, and other essential minerals lie at the bottom of the sea. Who will get this ocean treasure?

Not just the governments of one or two countries — if the United Nations has its way. A proposal is now before the General Assembly to make the sea bed, which covers 70 per cent of Earth, the common property of all nations. The U.N. wants to ban underwater military activity. And the world organization thinks that profits from sea mines should be used to develop the poorer countries.

Some Americans do not agree. In Congress, Representative Richard T. Hanna (Democrat from California) is proposing legislation that makes "finders-keepers" the rule. A private group, the National Oceanography Association, is also against the U.N. proposal. The N.O.A. says that U.S. oil companies will not be allowed to drill deep wells without permission if the U.N. proposal is passed.

U.S. Representative to the U.N., Arthur Goldberg, told the General Assembly that the U.S. thinks underwater sea areas are comparable to areas in outer space. Last year the U.N. got an agreement on the peaceful uses of space.

Goldberg pointed out that man does not know much more about the ocean floor than he does about outer space. Goldberg said that scientists expect the ocean floor to be a source of new foods as well as valuable minerals.

A U.S. expedition recently located a rich mineral find in the Red Sea, halfway between Saudi Arabia and the Sudan. The scientists, on an expedition from Woods Hole Oceanographic Institution, were drilling deep sea holes in a study of basins of hot sea water in the area. Minerals valued at 1.5 billion

NEWS

dollars were discovered in one section of the find.

The chances are that the use of these riches from the Red Sea will be debated for a long time.

Sweeping the Ocean Floor

Diplomats will be above water in their debate on what to do with the riches on the ocean floor. Scientists, of course, will not. Their work next year will take them four miles under water, and they will even burrow 2,000 feet below the bottom of the sea.

An 18-month project of deep-sea drilling will soon be started to find out whether or not the Earth's continents were once joined together. The new project will be the most thorough scientific investigation ever made of the underwater portion of the Earth's surface.

Scientists have picked 70 sites in the Atlantic and Pacific Oceans, and in the Gulf of Mexico and the Caribbean Sea. From these, they want to bring samples of rocks and sediments to the surface. From the rocks, they will learn the age of the ocean basins. Scientists also think they can learn something about climates and ocean currents millions of years ago.

Drilling sites in the Atlantic and the Pacific have been chosen so that scientists can get samples from the oldest parts of the ocean floor. Scientists think that the oldest parts of the ocean floor will be found in the northwestern part of the Pacific or in the Caribbean. Sites in both of these areas will be drilled.

Scientists also hope to find ocean fossils (traces of plants or animals that have been buried in stone) in the rocks they bring up from the deep holes. These, they think, may give them some clues to the kinds of animals that lived millions of years ago. And the fossils may also be a clue to the kind of climate on Earth in past ages.

A ship with special drilling equipment will be built for this project. The project will be directed by the University of California's Scripps Institution of Oceanography. Working with Scripps will be the University of Miami's Institute of Marine Science, Columbia University's Lamont Geological Observatory, and the Woods Hole Oceanographic Institution at Woods Hole, Mass. The National Science Foundation will finance the 5.4 million dollar operation.

Scientists are able to drill with precision at such depths because of research done for the now-abandoned Mohole Project. This project, in which scientists would have dug 10 times as deep to sample materials beneath the oceans' surfaces, came to an end last year when Congress refused further funds.

News Briefs

▸ Dentists may soon fight tooth decay with a shot in the arm. Scientists at Notre Dame think they have found a vaccine that resists tooth decay bacteria.

▸ Two six-inch dibblers – small Australian marsupials once thought to be extinct – recently were captured in the western part of Australia.

▸ In five years you may be crunching four ears of corn on the cob a day rather than drinking four glasses of milk. This year, scientists are testing corn that has the protein value of milk.

▸ The best color television may come from black and white film. Scientists and television technicians are looking into a new black and white film which shows full color when used with a special projector.

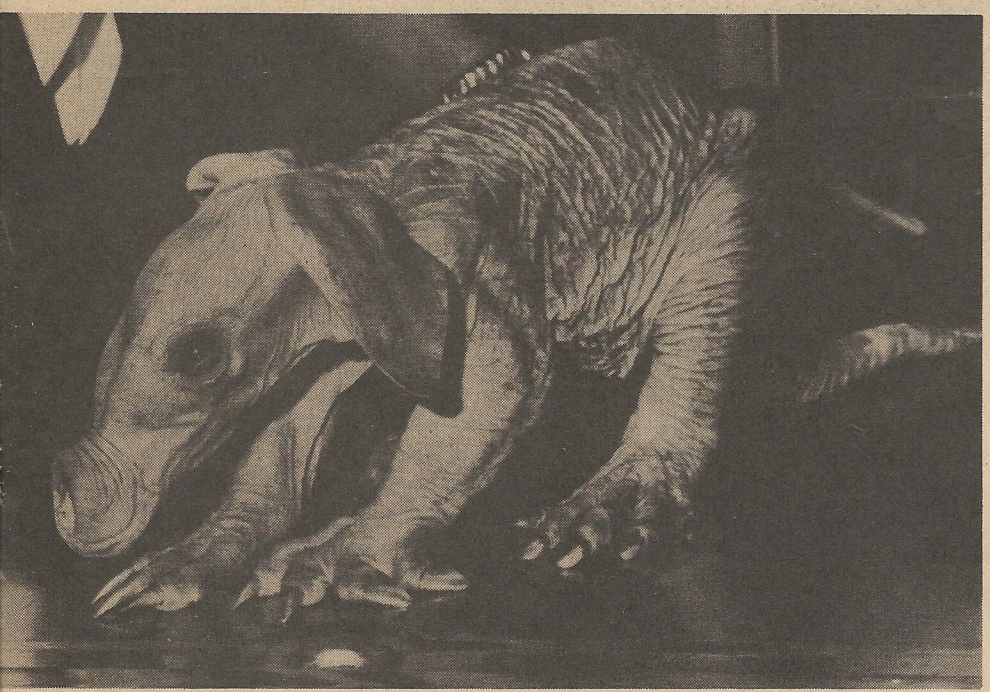


Photo from AP

It's a girl! And the pink, hairless creature is the pride of the nursery at Miami's Crandon Park. She's the second zoo-born aardvark in the world. At right, another proud mother, Grace the Giraffe, nuzzles her 5-foot tall son. He's only hours old at the Dudley Zoo in Great Britain.

Photo from Keystone

today's scientists

Dr. Milo D. Appleman
He Fights Food Poisoning

"IT MUST have been something I ate!"

You've probably said that many times, to explain some violent stomach upset. And your diagnosis was probably quite right. The "something" was likely a small culture of a bacteria called *Salmonella,* which is responsible for some 50,000 reported cases of food poisoning each year, and perhaps a million more unreported ones. Or, you might have had a bout with *Staphylococcus,* or "staph," which is less common but produces the same symptoms.

These and other microorganisms that contaminate food are the business of Dr. Milo D. Appleman. A professor of bacteriology at the University of Southern California, his specialty is food microbiology.

According to Dr. Appleman, there are about 1,200 varieties, or *serotypes,* of *Salmonella.* Most of them will make you mildly uncomfortable but are not really dangerous, except occasionally to the very young or very old. Three types of *Salmonella* are potentially fatal, and are better known as typhoid, paratyphoid A, and paratyphoid B. Fortunately, these have been virtually wiped out in the United States.

Food poisoning organisms live in the intestinal tracts of men and animals. When you eat contaminated food, the organisms enter your intestinal tract and multiply there. The unpleasant symptoms you feel after eating *Salmonella* are mostly the body's efforts to get rid of the parasites. *Staphylococcus* produces a toxin (poisonous substance) that makes you ill.

Some people may have one or more strains of these bacteria living in their bodies without themselves experiencing ill effects; they are called *carriers.* Most typhoid carriers have been found and treated or isolated, but carriers of the milder bacteria are all around us. If a carrier is working at food preparation and fails to wash his hands carefully after using the toilet, he may contaminate the food with bacteria from his body wastes. Another source of contamination, Dr. Appleman says, is the curious supermarket shopper who opens jars of food to smell or taste; this is particularly dangerous, he says, with meats and vegetables packed as baby food.

Salmonella is also frequently found in farm animals; uncooked meats, poultry, milk, and eggs may be contaminated. "Cooking destroys the bacteria, but then someone may take the cooked chicken and cut it up on a board that was used to clean and cut the raw poultry," Dr. Appleman points out. *Salmonella* has also been spread by pet turtles; Easter chicks, ducklings, and rabbits; and even drugs made from animal organs. Farm animals are often reinfected when the offal from the slaughterhouse is returned to them as food.

Working as a consultant to the U.S. Food and Drug Administration and the National Institutes of Health, Dr. Appleman is studying the biochemistry and physiology of food poisoning organisms. He is also trying to improve methods of detecting them in food.

Testing for Contamination

The usual indicator is another type of intestinal bacteria called the coliforms. Where there are a few *Salmonella,* there may be millions of coliforms. To test for contamination, you grind up a small quantity of the suspected food, emulsify it with distilled water, then place a few drops of it in a medium that encourages bacterial growth, and watch the results.

Currently, Dr. Appleman is studying two strains of another common intestinal bacteria, *Streptococcus,* which may make a better indicator. He has developed a culturing medium containing chemicals that "knock out" the coliforms and encourage the streptococci. Since these strains are found only in human wastes, their presence will indicate the presence of human, rather than animal, pollution.

Dr. Appleman watches as assistant N. Ron Walters works through wall of isolator used in germ-free studies

Photo by William Steele

About now you're probably saying something like, "I'm glad I don't have all those bugs living in *me*!" Well, think again. You, along with every other human being – in fact, every creature with a digestive system – carry millions of bacteria and other microorganisms in your intestinal tract and in other parts of your body. Most of them are beneficial; in fact, the ones in your digestive tract help with the digestive process. These bacteria are called the *beneficial intestinal flora.*

Your body began to pick up bacteria and large viruses almost from the instant you left your mother's womb. Your mother had similar organisms in her system, but they normally couldn't cross the placental barrier that separated her bloodstream from yours. A few viruses and bacteria do cross this barrier before birth – the viruses causing German measles and the bacteria causing syphilis are notorious for this property.

Scientists have long wondered what animals would be like without contaminating microorganisms. In 1932, workers at the University of Notre Dame began to develop techniques for raising germ-free animals. (There were earlier, short-lived attempts as far back as 1895.) Currently, thousands of germ-free animals are raised each year in the United States. They are mostly rats,

mice, and chickens; but cats, dogs, sheep, pigs, rabbits, goats, guinea pigs, monkeys, cattle, and turkeys are sometimes included.

In a small laboratory at USC, Dr. Appleman is supervising the establishment of the world's only existing colony of germ-free fish. It won't be the first, he says: A few germ-free guppies were raised about 20 years ago, but they lived only a few weeks, and never reproduced. Dr. Appleman hopes to have the first germ-free fish to beget germ-free offspring.

The project was first proposed by graduate student N. Ronald Walters, who now does most of the work on it under Dr. Appleman's supervision. The work is financed by the Office of Naval Research.

The subject of the experiment is a small tropical fish called *Xiphorphorous helleri*, a popular aquarium fish better known as the "swordtail." It was selected because it gives birth to its young alive. The first step in producing germ-free fish is similar to that used with other animals, with some modifications: The young are surgically removed from the womb before birth, under sterile conditions, and placed in isolation. Mr. Walters operates on the pregnant fish on a small table bathed in the light of an ultraviolet sterilizer. After opening the pre-sterilized abdomen, he removes the tiny embryos – up to 20 from one mother – with an eyedropper and places them in a screw-top flask of sterile liquid containing the salts, amino acids, and vitamins they need for nourishment.

Because heat would decompose the nutrients in this liquid, it is sterilized by forcing it through a cellulose acetate membrane with holes only 0.22 micron in diameter. This keeps out bacteria, which run about 5 microns across, and most large viruses, which measure from 0.5 up to 1 micron.

Germ-Free Isolators

The newborn germ-free fish are kept in the flasks for about a week, during which time they are tested to be sure they are free from contamination. Then they are transferred to tanks kept inside transparent plastic "isolators." The isolator, developed several years ago at Notre Dame, is a sort of tent made of transparent vinyl plastic, kept inflated by a blower. Everything inside the isolator is sterilized to begin with, including the water in which the fish are to live. Shoulder-length rubber gloves are sealed into the wall of the isolator so that the experimenter can handle objects inside, although he is still "outside." Anything that is to be put into the isolator is placed in a tightly capped flask and passed through a trap containing a powerful germicide.

(Techniques like these are finding uses outside the laboratory: Hospitals have found that burn patients and premature infants have better chances of survival if they are placed in isolators to protect them from infection. And the first Apollo astronauts to return from the moon will be kept in isolation until we are sure they are not contaminated with alien microorganisms.)

The fish so far have been fed commercial fish food that has been heat-sterilized, then enriched with vitamins to replace those destroyed by the heat. Apparently, something still has been left out, for most of the germ-free fish have been dying after about three and a half months. Mr. Walters and Dr. Appleman believe the deaths are caused by a nutritional deficiency, and have high hopes for a new, commercially made, sterile food product.

Aside from these problems, are the germ-free fish "healthier" than their contaminated cousins? Probably not. For the moment, let's just say that germ-free animals are different.

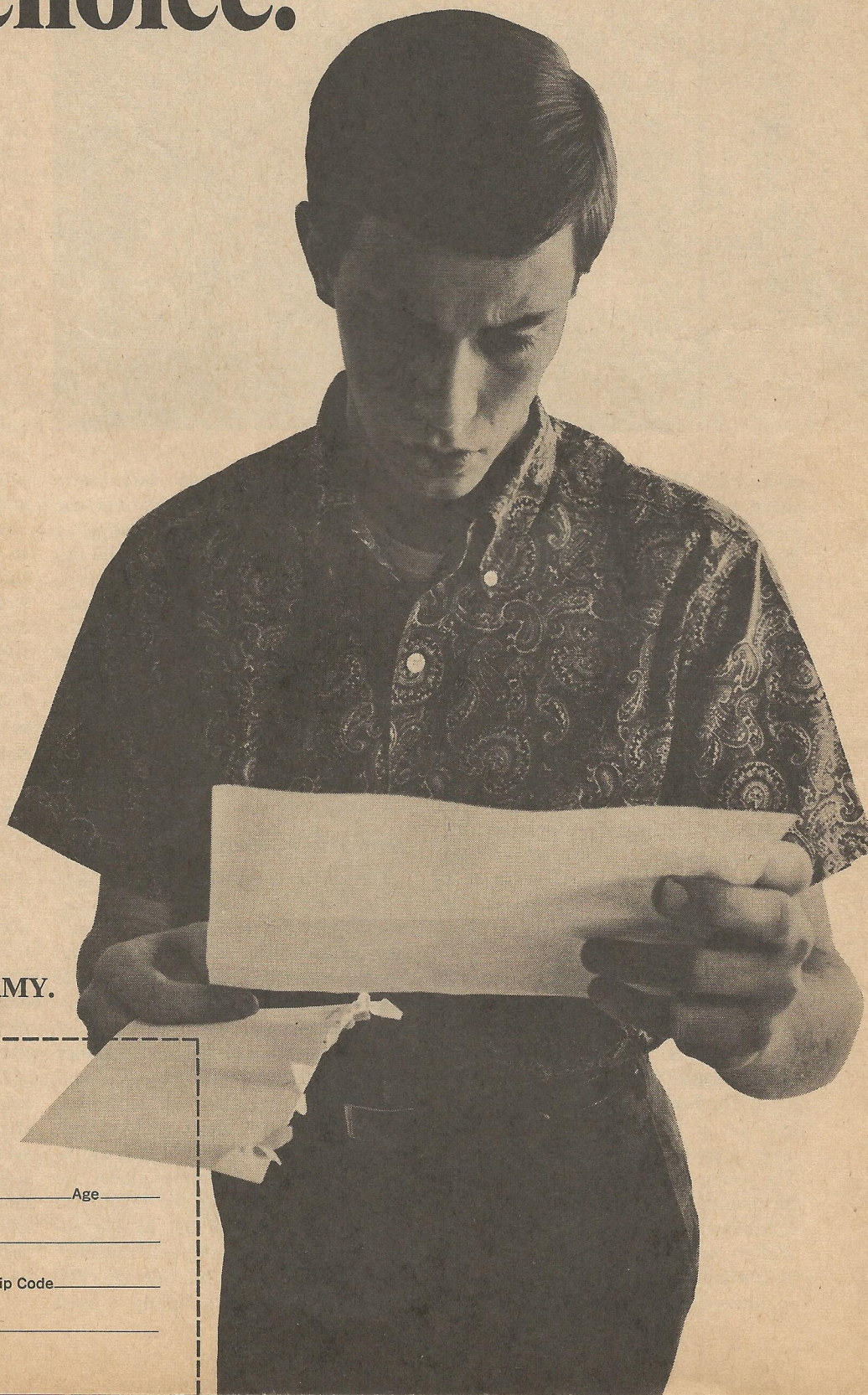
One of the chief differences is in the intestine. In normally contaminated animals, the intestinal flora help to break down complex substances in the food so that they are more easily transferred through the intestinal wall to the bloodstream. In germ-free animals, the intestines are distended – swollen; the larger surface area accomplishes the same amount of transfer without bacterial help. In some animals this distention is so great that the animals die of "gut strangulation"; in others, the distended intestines press upon the reproductive organs and interfere with their function.

In their bloodstreams, germ-free fish and animals differ in having less of a group of blood proteins, known as gamma globulins, which includes the antibodies the system uses to protect itself from bacterial disease. When animals have been bred and raised through several germ-free generations, the gamma globulins diminish further with each successive generation.

Raising germ-free fish fell naturally into the pattern of Dr. Appleman's studies of food poisoning. In 1962, he spent a year at the Torrey Marine Research Station in Scotland, tracking down the sources of contamination of fish caught in the North Sea. He found that fish caught far at sea, away from waters polluted by man, were free of

Continued on page 21

He just lost his chance to make a choice.



His induction notice caught him with his decisions down. He waited too long to choose Army.

If he had acted sooner, he would have had his pick of more than 300 jobs. And his choice would have been guaranteed in writing *before* he joined up.

So don't wait. Choose your specialty and get the best training in the world. In an outfit you can be proud of. There's no better way to become highly skilled. No better way to fulfill your military obligation.

Your future, your decision . . . choose **ARMY.**

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PROJECT POINTERS

Migration of Na Ions Through Glass

HERE is an interesting and unusual project that demonstrates the migration of sodium ions through glass, and also produces a small quantity of metallic sodium.

A *vacuum* light bulb is essential for this project. Obtain a 25-watt clear tubular showcase bulb, made by G.E., Westinghouse, or Sylvania (they are sometimes used to light fish tanks).

WARNING: *Do not* use a standard light bulb, whether clear glass or not. Most light bulbs contain a mixture of gases. *Make certain that you have a vacuum bulb.*

Screw the bulb into a porcelain socket and clamp the socket upside down onto a ringstand (see Fig. 1). Connect the socket to a standard lamp cord and plug. At the bottom of a plain agate or enamel pan on the ringstand, place a piece or rod of clean iron, or a graphite (carbon) rod. Or, use clean iron gauze like that used to support beakers over bunsen burners.

The iron or graphite rod will be connected by wire to the positive terminal of a 45-, 67½-, or 90-volt radio "B" battery (or battery substitute). The negative terminal of the battery is to be connected to either side of the porcelain socket, as shown in the diagram.

CAUTION: Such DC voltages can be dangerous, and you are also working with 110-volt AC. Carefully observe electrical safety precautions at all times; do your work under the direct supervision of your science teacher, and have him check your setup and wiring before proceeding.

Add to the pan a mixture consisting of crystalline sodium nitrate C.P. (95 per cent of the mixture by weight) and pure sodium chloride (5 per cent). Heat the mixture with two Meeker or Fisher burners until molten. Then adjust the flames so that the surface just stays liquid (about 350°C). Now lower the lighted bulb gently about one inch into the molten salts.

After a time, a grayish cloud will form inside the bulb. Disconnect the current and lift the hot bulb from the molten salt. You will see that the inside surface of the lamp is covered with a silvery layer of metallic sodium.

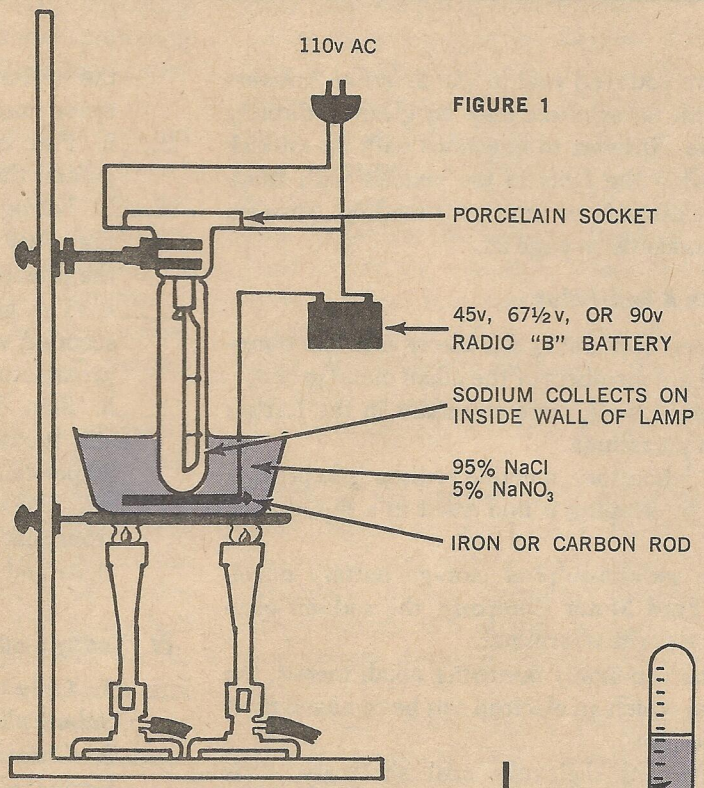

FIGURE 1

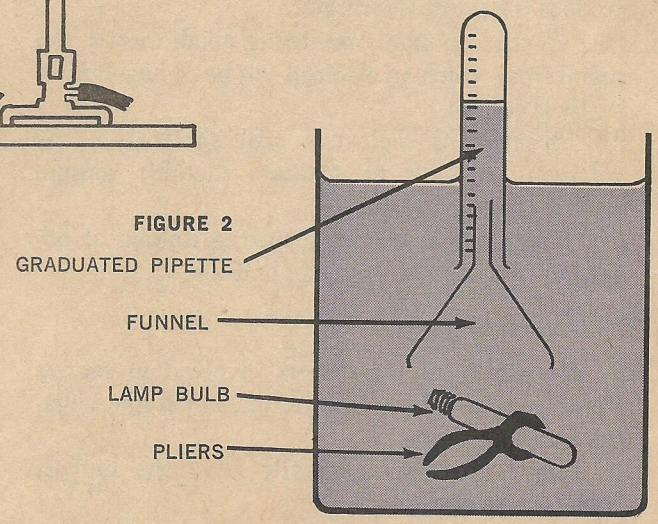

FIGURE 2

BREAK BULB UNDER WATER

The sodium ions from the molten salts have replaced some of the sodium in the glass, releasing free sodium ions to collect on the inside. These positive ions have a strong electron affinity, and attract some of the electrons emitted by the lamp filament. Thus the ions become atoms of sodium metal.

How can you show that the silvery coating is really sodium? Put the bulb in a cloth sack and immerse it in water. Using a pair of pliers, carefully break the bulb under water. The sodium will react with the water, forming hydrogen gas and sodium hydroxide. Quantitative measurements can be made by using a funnel to collect the hydrogen in a graduated pipette (see Fig. 2).

Determine the DC voltage that produces the greatest sodium ion migration. At what voltage does migration stop?

—ALEXANDER JOSEPH

SCOREBOARD

How well have you read your *Senior Science*? Answers to questions with no asterisks may be gleaned directly from the articles. Answers to questions with an asterisk (*) require fusing the facts in the articles with those learned in the classroom or from your reading. Answers are in the SCOREKEEPER on page 20.

I. Na & K—The Alkali Twins

_____1. All atoms containing one electron in the outermost shell are members of the alkali metal group.

_____2. Sodium is much more abundant in the Earth's crust than potassium.

_____3. In the laboratory, metallic sodium is kept from oxidizing by keeping it immersed in a liquid such as water.

_____4. In the sodium-sulphur storage battery developed by Ford Motor Company, the sodium electrode is the positive terminal.

_____*5. Of the commonly occurring alkali metals, the metal from which an electron can be removed most easily is cesium.

_____*6. Because of their chemical similarity, it is relatively difficult to separate metallic sodium from metallic potassium.

_____*7. There is a naturally occurring isotope of potassium with a relatively long half-life.

II. The Accident Plague

_____1. A majority of the drivers involved in serious traffic accidents have had histories of traffic violations and accidents.

_____2. Congested areas generally have the highest traffic death rate.

_____3. It can be definitely shown that most accidents are the result of poor automobile design.

_____4. When a traffic sign indicates that the speed limit is 50 miles per hour, this is the safe speed under any conditions.

_____5. Road-safety planning need not involve the public, but can be left entirely to the experts.

_____*6. The braking distance for a car traveling at 50 miles per hour is twice that for a car going at 25 miles per hour.

III. Man Under the Sea

_____1. At a depth of 100 feet under the surface of the water, the pressure is approximately three times normal atmospheric pressure.

_____2. Pure oxygen cannot be breathed at pressures greater than two atmospheres.

_____3. Nitrogen is a relatively inert gas and does not cause any physiological problem, regardless of the pressure at which air is fed to a diver.

_____4. The greatest depth to which divers have descended without rigid suits or diving bells is approximately 1,000 feet.

_____5. Skin divers who work at great depths must still breathe an atmosphere that is approximately 20 per cent oxygen.

_____*6. The velocity of sound in hydrogen is different from that in air because of the difference in elasticity and density of the medium.

IV. Today's Scientists

_____1. Only human beings are susceptible to the *Salmonella* organism.

_____2. Germ-free fish are healthier than their contaminated cousins and generally live longer.

_____3. Germ-free fish are obtained by chemically sterilizing the fish.

_____4. In most animals, the presence of intestinal flora aids in the digestion and assimilation of food.

_____5. Gamma globulin contains many of the antibodies needed to protect the individual from bacterial diseases.

_____*6. *Salmonella* is more resistant than most forms to the action of antiseptics used in smoking and pickling foods.

_____*7. A characteristic of the *Salmonella* organism is its ability to produce acid and gas from dextrose sugar.

Going Beyond

1. Until 1946, elements 43, 61, 85, and 87, though discovered, were unnamed. Today we know them as technetium, promethium, astatine, and francium, respectively. Why were these elements unnamed prior to 1946? What have these four elements in common?

2. On the basis of their atomic structure, explain why the alkali metals are soft, malleable metals with low melting points and low boiling points.

ANSWERS TO BRAIN TEASERS

(see page 20)

Balance Sheet

There is no relationship between the sums of the two columns. It is just coincidence that they are close together. If Horace's starting balance had been $154 instead of $54, the sum of his remaining balances would have been $552 instead of $52, while his total withdrawals would still be $54.

Marriage Muddle

Since Mrs. Hathaway's brother's wife was Mrs. Fosdick, then her brother must have been Mr. Fosdick. Then she, Mrs. Hathaway, was originally a daughter in the Fosdick family. Thus the Fosdick daughter married the Hathaway son. Once this is established, the only possible matches remaining are the Hathaway daughter married to the McCoy son, and the McCoy daughter married to the Fosdick son.

Time Teaser

Three hundred and sixty hours later they will both show 6 o'clock.

Editor's Choice

Friction is the answer. As you move your fingers together from the ends of the yardstick, the friction between each finger and the yardstick will vary slightly, due to the smoothness of the stick, moisture, etc. If one finger encounters less friction than the other, it will move closer to the center. But as it does so it supports more of the weight of the stick, and the friction on that finger increases. Accordingly, the other finger catches up in its move toward the center of the stick. This repeats itself over and over again until the two fingers are at the center.

Just the opposite is true when the fingers are moving away from the center. One finger will start to move first, and immediately it will be supporting less of the stick's weight than the other finger. Accordingly, less friction will exist between the stick and this finger. It will continue to move out to the end, while the other remains at the center.

IT MEANS A LOT

AMERICAN RED CROSS VOLUNTEER

Wear the Red Cross volunteer emblem. It means *you* care enough to help. Wear it proudly.

YOU CAN HELP TOO.

FOLLOWING THE FILMS

GONE WITH THE WIND
(M-G-M)

If there is such a thing as a vintage film, it has to be *Gone With the Wind.* Time fails to age it, nor does custom stale its value or spectacular charm. Originally released in 1939, it won 10 Academy Awards. It was re-released in the 1950's and again during the Civil War Centennial in 1961. Now it is making another comeback, but this time it is bigger, brighter, and louder. Its original small negative has been reshot on giant screen 70 mm. film, and stereophonic sound and enriched color have been added. But not a scene has been dropped. The "new" *Gone With the Wind* is still the old *Gone With the Wind,* thank goodness.

Like *Dr. Zhivago,* "GWTW" shows the agony of individuals against the backdrop of the agony of a nation divided by civil war. Its setting is Georgia, and one of its most impressive scenes convincingly re-creates the burning of Atlanta. Its characters are recognizable human beings whose lives are warped and reshaped by the events through which they live. Scarlett O'Hara (Vivien Leigh) loves Ashley Wilkes (Leslie Howard), but it is Rhett Butler (Clark Gable) whom she marries. Scarlett is the central figure of the story's conflicts. Fascinating, selfish, resourceful, her essential "humanness" puts the audience squarely on her side from start to finish.

Gone With the Wind makes its contribution as a film classic on many levels. It is a love story, an adventure story, a somber portrait of a historical era. It is also a gallery of unforgettable character studies. If you are seeing it for the first time, you will understand why no film maker has ever tried to recast the roles in order to make a new version of this movie. The actors who played the major parts are probably solidly identified with their roles for all time. It is sad to realize that, of all these fine performers, only Olivia de Havilland, who played "Melanie," is still living.

WAIT UNTIL DARK
(Warner Bros.)

On the Broadway stage, Frederick Knott's play *Wait Until Dark* was a lightweight contender for the thriller title. The film version is still far from the champion class, but thanks to a grisly characterization by Alan Arkin, is packs a bit more punch.

The main trouble with *Wait Until Dark* is its credibility gap. We are asked to believe that a New York photographer (Efrem Zimbalist, Jr.) innocently acquires a doll stuffed with heroin. Okay. We are assured that, to him and his blind wife Susy (Audrey Hepburn), it's just a doll. But it represents a fortune to three unsavory gents – Mike (Richard Crenna), Carlino (Jack Weston), and Roat (Alan Arkin) who know what it contains. Again, Okay.

From this point on the plot gets harder and harder to take. The photographer is decoyed out of town, and the hoods ramble in and out of Susy's apartment. To con her into giving them the doll, they tell her a string of melodramatic whoppers and assume various false identities. All the playacting gets them nowhere. Even Susy can see through them.

Alan Arkin makes the last part of this film hair-raising as he lunges and plunges around the apartment after the terrified Susy. But even his expert skulduggery won't keep you from noticing those gaping holes in the plot. Why, for example, doesn't Susy call the police or leave the apartment when she has sent all three thugs off to search her husband's studio several blocks away? Why does she send the neighbor's helpful child to the bus terminal instead of the police station? Why didn't screenwriters Robert and Jane-Howard Carrington, who adapted the play for the screen, tidy up some of these illogical loose ends? Why, why, why?

— MARGARET RONAN

Gone With the Wind has received the *Scholastic Magazines* Bell Ringer Award. These awards are given to motion pictures that meet *Scholastic Magazines'* standards of excellence in direction, acting, photography, and appropriateness of subject matter.

BUY U.S. SAVINGS BONDS

ANSWERS TO PUZZLE (see page 24)

	P	E	R	I	H	E	L	I	O	N	
C		M	A	C	E		I	N	N		C
A	N		S	O		C	O	D		I	O
S	U	N		N	O	O	N		T	A	P
S	T	A	R		E	T		J	U	N	E
I		B	U	N			N	U	N		R
O	B		B	E			I	N		O	N
P	I	T	Y		H	O		O	M	N	I
E	B	B		H	E	A	R		S	A	C
I	S		C	A		R	E	O		N	U
A		N	I	L	E		S	U	P		S
	R	E	V	O	L	U	T	I	O	N	

SENIOR SCIENCE - 10-19-67

ANSWERS ON PAGE 19

brainteasers

Balance Sheet

Horace the Hermit maintains a modest bank account. A month ago he purchased the Brooklyn Bridge on the installment plan. Since then he has made four withdrawals from his bank account, as follows:

1st withdrawal	$20	remain. bal.	$34
2nd withdrawal	$20	remain. bal.	$14
3rd withdrawal	$10	remain. bal.	$ 4
4th withdrawal	$ 4	remain. bal.	0
	$54		$52

Poor Horace just could not get the two columns to equal each other. Can you tell him why the total of his remaining balances does not equal his total withdrawals?

Alan Percher
Syosset H. S.
Jericho, N.Y.

Marriage Muddle

The Hathaways, the McCoys and the Fosdicks had been feuding for many years. One day the three families were forced to unite against the threat of an Indian attack. From then on the families became friends. As an expression of their new friendship one daughter and one son from each family married members of the other two families.

One day after the three couples were married, the women were sitting and talking. Mrs. Hathaway remarked to her brother's wife, Mrs. Fosdick, that times certainly had changed.

Which daughters married which sons from the three different families?

Michael Tresidder
Balmoral Jr. Secondary S.
Vancouver, B. C.

Do you have a favorite brain teaser? Send it to Senior Science, 50 West 44th St., New York, New York 10036. We will pay five dollars for each one published. Include the name of your school, home address, grade, and age. In case of duplicate submissions, choice will be made on the basis of presentation and clarity.

Time Teaser

Two clocks register midnight at exactly the same moment. What makes this unusual is that one clock is gaining exactly one minute every hour and the other is losing exactly one minute every hour. How long will it be before the two clocks show the same time again? What time will they both show?

Sarah Lincoln
Alamosa Jr. H. S.
Alamosa, Colo.

Editor's Choice

Place your extended index fingers underneath the flat side of a yardstick at each end. Move your fingers together slowly. Your fingers will always meet at the center of the yardstick.

Now try it the other way around. Place your extended fingers together and balance the yardstick on them. Now try to draw your fingers apart so that the yardstick will rest with one end on each finger. You'll find that it won't happen. One finger moves toward one end, while the other remains at the center of the yardstick.

Can you explain why?

Scorekeeper

(see page 18)

I. Na & K – The Alkali Twins
1.F; 2.F; 3.F; 4.F; *5.T; *6.T; *7.T.

II. The Accident Plague
1.F; 2.F; 3.F; 4.F; 5.F; *6.F.

III. Man Under the Sea
1.T; 2.T; 3.F; 4.F; 5.F; *6.T.

IV. Today's Scientists
1.F; 2.F; 3.F; 4.T; 5.T; *6.T; *7.T.

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For Further Reading

Man Under the Sea

Coyle, Arthur J.. "R & D Implications of the Man-in-the-Sea Program," *Battelle Tech. Rev.*, May 1966. Reprints available from Battelle Memorial Inst., 505 King Ave. Columbus, Ohio 43201.

Stenuit, R. P., "Life and Work Under Pressure," *Discovery*, May 1966.

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Backett, E. Maurice, *Domestic Accidents*, World Health Organization.

Galton, Lawrence, "Highway Safety: Fables and Facts," *Backgrounder*, June 1966, Purdue University Schools of Engineering.

Johnson, William, "Clutter Is Out – Safety Is In," *Traffic Safety*, Sept. 1967.

Menninger, Karl, *Man Against Himself*, Harcourt, 1956.

Accident Facts, 1967 ed., National Safety Council.

Mortality Trends in the U. S., Dept. of Health, Education and Welfare.

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Ihde, Aaron, *The Development of Modern Chemistry*, Harper & Row, 1964.

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Tepper, F., King, J., and Greer, J., "Multicomponent Alkali Metal Alloys," paper presented to the International Symposium on the Alkali Metals, July 1966.

Today's Scientists

continued from page 15

food-poisoning organisms. But as soon as they were handled by the fishermen, they picked up organisms and became more and more contaminated as they passed through further handling steps on their way to the retail market.

Now Dr. Appleman hopes to use germ-free fish to find out more about how this contamination works. Do the bacteria become part of the permanent intestinal content of the fish, or are they merely transients? By infecting a germ-free fish with one, or perhaps two, known species of bacteria at a time, he hopes to find out. Like all scientists, he wants to reduce his experiments to as few variables as possible. This is why he uses germ-free fish. With them, the results are not confused by the presence of other "normal" strains of bacteria.

Mr. Walters and Dr. Appleman also plan to repeat with fish an experiment conducted a couple of years ago at Notre Dame. There, germ-free mice were accidentally infected with disease-producing *Salmonella*, but they suffered no ill effects. Only when "normal" intestinal flora were also introduced did the mice become ill. The long-range goal of all these experiments, of course, is to learn how these bacteria work to produce disease in man.

Dr. Appleman has been working in one phase or another of food microbiology and public health for more than 30 years. As an undergraduate at the University of Illinois, he studied chemistry, but switched to bacteriology because "there seemed to be more problems to be solved—or maybe the problems were more interesting."

A couple of afternoons a week, Dr. Appleman works as a consultant to several commercial food-processing companies, mostly helping them solve their sanitation problems. Working a 19½-hour day (he rises at 4:30 to go to work at 6:00, seldom goes to bed before midnight) has given him time to obtain several patents. Among them are ones covering processes for making previously discarded food by-products into dog food and cattle food, and one for a water purification unit for campers or soldiers that weighs about 50 pounds. The latter resulted when he was asked if he could pare a little weight off the 1,000-pound unit used by our troops in Vietnam.

"People bring me puzzles to crack, and I crack them," he explains.

— WILLIAM STEELE

DISC-USSIONS

THE BEST OF THE NEW LPs

BY ROY HEMMING

with Robin McBride, Ed Coach, Buzz Royden

CLASSICAL ALBUM OF THE WEEK

Rachmaninoff: — Symphonic Dances [*Vox Turnabout TV341458*]. Rachmaninoff's last large-scale symphonic work (1940) is a marvelously melodic and colorful work (whose three sections were once subtitled Youth, Maturity, and Decline). It was written for and dedicated to Ormandy and the Philadelphia Orchestra. Curiously, Ormandy's own recording [*Columbia MS6205*] was disappointingly heavy-handed. In fact, I had never heard a completely satisfactory performance of the work from anyone (including Leinsdorf, Steinberg, Mitropoulos, and Goosens) until Johanos. His is a vividly brilliant performance—projecting certain parts with fire and zest, others with sparkle and lilt, and still others with the throbbing warmth of old-fashioned romanticism. The Dallas orchestra may not be the lush, impeccable instrument the Philadelphia is, but its performance is still highly polished and admirable. (R.H.)

Gershwin: Porgy and Bess Suite; & An American in Paris—Steinberg, Pittsburgh Symphony [*Command 11037*]. We've come to expect the best in hi-fi sound from Command, and this LP is no exception. What is a surprise, however, is to find Steinberg (the Brahms, Beethoven, and Bruckner master) giving these popular Gershwin works the best performances they've yet had on records (and there've been some good ones, too, by Reiner, Bernstein, Fiedler, etc.). These are rousingly spirited, wonderfully bluesy, just-about-perfect performances. (R.H.)

Felicia Weathers—Puccini and Verdi Arias [*London OS26014*]. Miss Weathers is the young soprano from St. Louis who has been garnering all sorts of fine notices in European opera houses. Her first LP reveals a voice which impresses less for its natural beauty than for the unique clarity of phrasing and dramatic impact with which she uses it. The Puccini side of the LP is better than the Verdi—with a heart-rending version of "Senza Mamma" from *Suor Angelica* worth the price of the LP alone. (R.H.)

Guitar U.S.A.—Tony Mottola [*Command RS908SD*]. Virtuoso Mottola offers a real showpiece, with many strings attached. He plays every kind of guitar in every conceivable style, skipping facilely from unamplified classical gut-string guitar to acoustical 12-string guitar to various types of electric guitars. There is Philadelphia string band style ("Mame"), classical ("Scarlet Ribbons" and "Yesterday"), Nashville ("Your Cheatin' Heart"), folk rock ("Lemon Tree"), Tijuana ("Spanish Flea"), and solo concept in voice accompaniment ("Please" and "Shadow of Your Smile"). It's all great. (E.C.)

Big Ben Strikes Again—Jorge Ben [*Philips PHS600-234*]. Rio de Janiero's Ben (who used to be part of Sergio Mendes' group) has a little bit of Lou Rawls and Harry Belafonte in his singing voice, and a great big amount of pure Brazilian glow. Most of the tunes on this LP are Ben originals, abounding in samba beats and the expressive warmth that keeps Brazilian pop music ever popular. (B.R.)

Ode to Billie Joe—Bobbie Gentry [*Capitol ST2830*]. Bobbie Gentry may well be *the* music business phenomenon of 1967. She has a warm approach that sneaks up on you and then makes its way inside. Millions have heard (and bought) her single of the title tune, yet there are even finer surprises on her first LP—all original songs, too. Though a few are derivative of "Billie Joe," there are some beautiful ballads that have the stuff to become standards—especially "Sunday Best," "An Angel Died," and "Hurry Tuesday Child." (R.M.)

POPULAR ALBUM OF THE WEEK

The Love Album — Lainie Kazan [*MGM SE4451*]. If anything should break the unfair image of Lainie as "another Streisand," this LP should! The only thing that's

Kazan: "distinction"

Weathers: "impact"

comparable to Barbra here is Lainie's equally exceptional way of getting underneath the most mundane song and giving it distinction. If any stylistic comparisons must be made, the name of Felicia Sanders, Lena Horne, or Judy Garland might be raised, but even *that* wouldn't fairly describe the sultry, caressing intensity that is Lainie's alone. She's at her best here with "I Got It Bad and That Ain't Good," "Warm All Over," and "Take It Slow, Joe." (R.H.)

You Are Not Alone—Roy Black [*United Artists UNS15524*]. At 21, Black has become one of Europe's most popular exponents of "sweet rocking"—pining out his heart in Presley-like ballads tinged with an American country-and-western beat. This LP, mostly in German but with some songs in English, offers a generous sampling (14 tracks) of reasons why he's riding the crest in more than one country. (B.R.)

The Sound of Wilson Pickett [*Atlantic SD8145*]. One of the real gutsy R&B singers, Pickett really opens up and wails on this driving album with a sledge-hammer beat. Top grooves include "Funky Broadway," "Mojo Mama," and "Soul Dance No. 3." Pickett delivers soul music that hits so hard that it strikes even deeper than the nitty gritty. (R.M.)

Dear Carol: Several months ago, small spots appeared on my face in the same place where I previously had pimples. I've found that a lot of make-up hides these marks, but I'd rather get rid of them and have nothing to hide. Can you tell me what caused the spots to appear. Also, how can I make them disappear?

A. Small red or purple marks, such as you describe, often follow blemishes, but they do fade away in time. Meanwhile, rather than using a lot of heavy makeup, dot these spots with a white contouring cream. Then apply your regular amount of makeup over it.

Dear Carol: I'm five-feet-three inches tall, and would like to know what skirt length is best for my height.

A. Only after you take stock of your figure can you determine what skirt length looks best. Being on the short side to begin with, you shouldn't wear skirts thigh-high, since they'll make you appear shorter. And, if you have heavy hips, big thighs, bulbous knees, bowed or bony legs, stick to a longer, more protective length. If none of this fits your description, choose a short skirt – above your knees – but make sure it's flared or pleated. You won't be able to sit down in a tight one.

The new fall fashions are stressing skirt lengths that connect with stockings and shoes. Pale nylons are apt to make your legs look larger, so if your legs are less than perfect, you'll be better off wearing colored hose that will match your skirt. When buying shoes, remember that short skirts call for low heels. If boots are "in" in your community, don't buy the real high ones. Those over-the-knee boots make anyone under five-feet-five look unflatteringly short.

Dear Carol: I'd love to have attractive nails so that my hands would look prettier. How can I give myself a proper manicure?

A. First take off remnants of any old nail polish with polish remover and a cotton swab. Be sure to reach the corners where your nail meets the cuticle. Then file each nail with an emery board. The shape should be oval, not pointed, and the length shouldn't extend too far over your finger tip.

After filing, soften your cuticles by putting a bit of cuticle cream around each nail. Then soak finger tips in warm sudsy water. Dry your hands and use an orange stick to apply cuticle remover under and around each nail. Use clippers only as a last resort for removing rough cuticles. If you like nail polish, choose a natural or pale shade.

Remember: A weekly manicure is just the first step in keeping your hands attractive. Be alert to chipping that occurs between manicures, and tend to it immediately. One more thing: No nails, no matter how long and well-shaped, look attractive if they are dirty.

Dear Carol: What can I do about a noticeable dark line of hair over my upper lip?

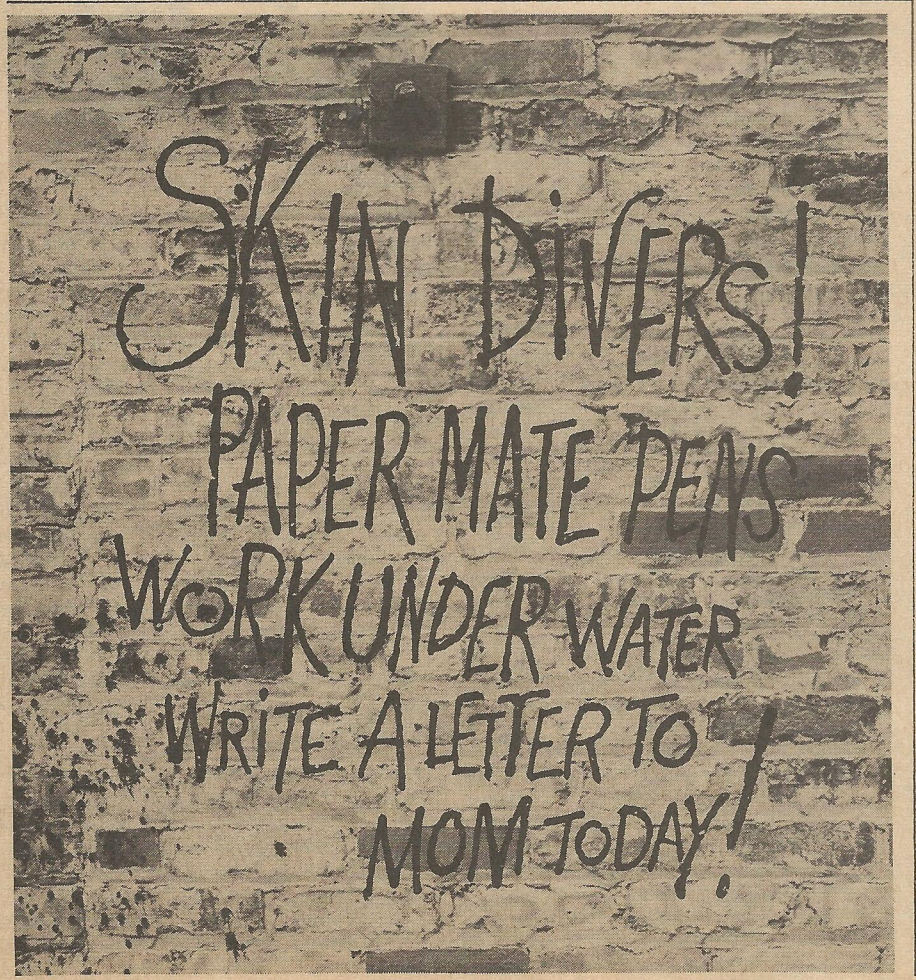
A. Lighten it with a mild bleaching solution. Mix two tablespoons of 20-volume peroxide with five or six drops of bleaching ammonia. Add enough mild soap flakes to make a paste. Leave mixture over your upper lip for five minutes, then rinse it off.

Dear Carol: I have a roll of fat around my waistline. What can I do to get rid of it?

A. Check your posture first. Very often, pulling your head up out of your neck, your neck up from your shoulders, and your rib cage up from your diaphragm will minimize a spare tire. Then do this exercise each day:

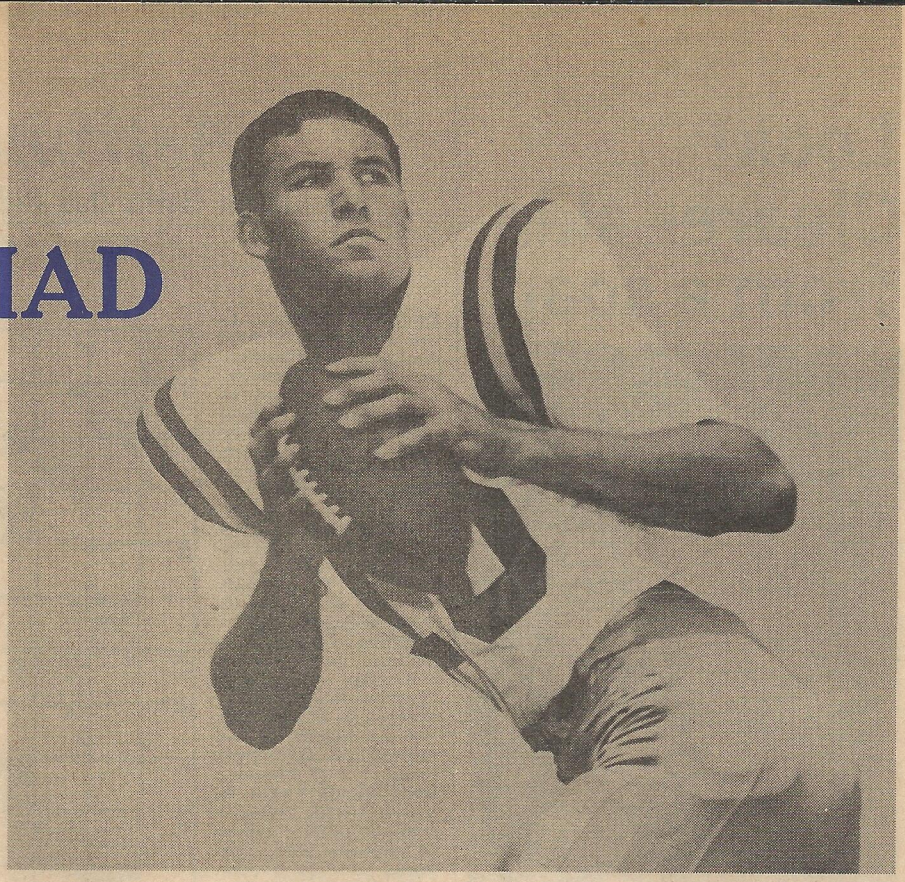
Stand with legs apart, arms out at shoulders. Now, keeping knees stiff, bend right hand to left foot. Do this ten times to each side. Feel that pull at your waistline.

"Here's Looking At You" is planned to help make YOU present an attractive appearance to others. Do you have questions you'd like to ask about your appearance? Girls – write to Carol Ray, Scholastic Magazines, 50 West 44th Street, New York, N. Y. 10036. Boys – write to Steve Daniels at the same address. Sorry, no answers by letter.



SPORTS

UCLA'S MAD BOMBER



WHAT is so rare as a day in June, a knight in a pool room, or a hippie in a bubble bath? I'd say a "bomber" in a college backfield – a quarterback who can throw a good long pass.

Most college passers rarely get to throw one. Their coaches refuse to let them play with "bombs." They feel that it will go off in their faces, causing terrible damage to the team's won-and-lost record.

This makes Gary Beban a rare young man, indeed. At 20 years of age, the 6-foot, 185-pound quarterback from UCLA is a master bombardier. He fires the bomb like a pro. Not just like any old pro, either, but like a Unitas, a Jurgenson, or a Namath. When he cranks up his arm and lets go, the defense always gets the shakes. Gary can hit a moving target almost anywhere in the ballpark.

As a sophomore, two years ago, he had everyone bug-eyed with his long-range missiles. He unloaded touchdown bombs of 22, 34, 34, 52, 60, 72, 76, and 79 yards. He also hit on four other plus-50 yarders that were erased by penalties, and on a number of other "longies" that set up scores. His aerial statistics for the year came to 1,483 yards and 9 touchdowns.

And when the enemy started bringing up their anti-aircraft weapons, Gary went after them on the ground. Believe it or not, the UCLA bomber also ran for 856 yards and 14 more touchdowns.

Put all these figures together and you arrive at a staggering offense record of 2,073 yards and 23 TD's! Some year for a soph quarterback, eh?

What can a guy do for an encore after an "act" like that? Gary came right back with another smashing season. Though now a marked man, the target of every opponent, Gary, in just nine games (a broken ankle kept him out of the last game), chucked for 1,245 yards and 6 TD's, and galloped for 595 yards and 10 TD's. Totals: 1,840 yards and 16 TD's.

Before Gary hangs up his bombsights this December, he will have smashed every passing record in the UCLA book and will also have galloped into a top spot among the Bruins' all-time rushing leaders.

The pros can't wait to get their hot fists on him. For Gary, besides being a pinpoint bomber and a running fool, is a flashy faker, a slick ball-handler, a smart play-caller, and a commanding leader.

All right, so he has a few flaws. He sometimes loses his cool in the face of a big rush, he runs a little too much for a quarterback, and he needs a little work on his short pitches. But what college quarterback is perfect? And none of Gary's flaws are serious. They can all be erased with a little work – and work and dedication are Gary's middle names.

Though Gary's fireworks caught most of the experts by surprise two years ago, it raised no eyebrows in California. They knew all about Gary. He had always been a dazzling athlete. Born in San Francisco and raised in nearby Redwood City, Gary starred in just about everything as a boy. He played Little League Baseball and Pop Warner Football, then went on to star in both sports, as well as basketball, at Sequoia High School.

On the diamond, he batted a cool .442 and showed a big league arm. Unfortunately he also showed a lot of "stone fingers" in the outfield. That kept the big league scouts away from his door.

In football, Gary played tailback in Sequoia's horse-and-buggy single wing formation. After he passed and ran the team to the All-Northern California championship, our *(Scholastic Magazines')* All-American Football Board picked him as an honorable mention on the 1963 All-American H. S. Team.

For a fellow who's rated as sure-fire pro material, Gary still works like a beaver on his game. He lifts weights to improve his strength, and he throws and throws and throws the football. He believes that, the more you throw, the stronger your arm will get and the better and longer you'll be able to throw.

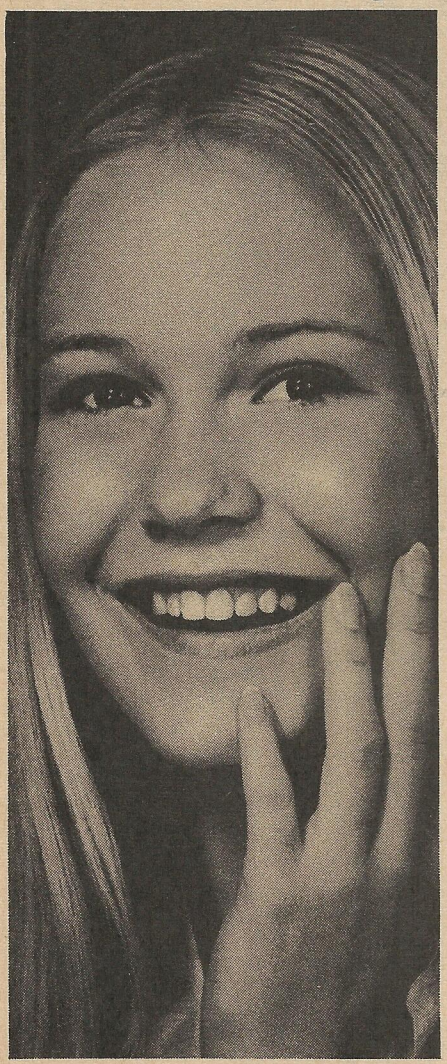
"I can throw the ball pretty far now," he says, "but I really don't know exactly how far. To be perfectly frank, I just hang the ball out there and let my ends run under it. But I know this: whenever I *have* to throw a little farther, I can manage to reach down and come up with that little extra."

A modest, popular student-athlete, Gary has a solid "B" average as a history major. He digs most of the normal things, but the movies rate No. 1. Even when Craig Morton and Paul Hornung used to be his football heroes, they never rated ahead of Paul Newman and Elke Sommer. Glenn Yarbrough is his favorite singer, *Stanton Street* his favorite song, and "The Man From U.N.C.L.E." his favorite TV show. For the most thrilling moment of his career, he picks UCLA's upset victory over Michigan State in the 1966 Rose Bowl Game.

Gary's big ambition is to become a teacher. But it doesn't look as if he'll see the inside of a classroom for about 10 years or more. He should be pitching bombs – and making barrels of money doing it – for some pro team.

– HERMAN L. MASIN, *Sports Editor*

Look! Clearer skin from a soap



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It actually helps clear your complexion simply by washing your face!

Jergens' rich, specially medicated lather washes away excess oiliness. Fights blemishes. Fights the bacteria that make them grow.

Continued use helps keep blemishes from coming back. Yet this clear, transparent soap never dries or irritates your sensitive skin.

Try it.

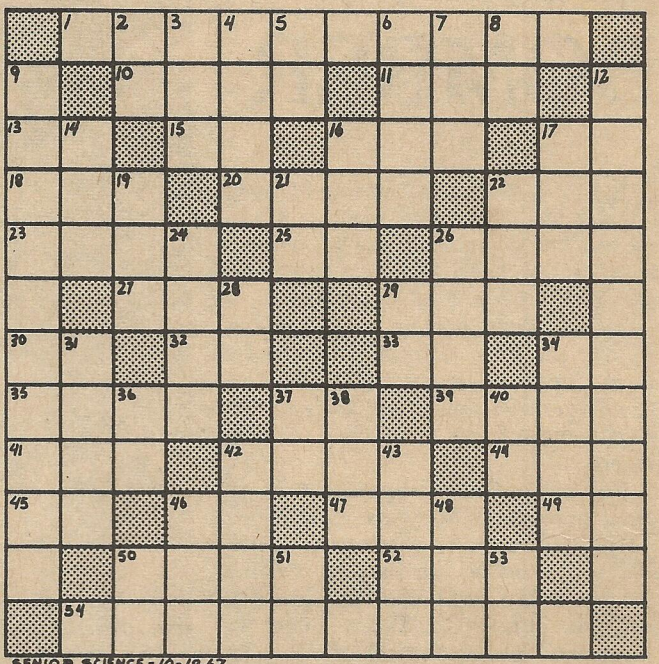
FROM THE JERGENS SKIN CARE LABORATORIES

Astronomical

By Allison Davis, Oak Ridge H. S., Oak Ridge, Tenn.

★Starred words refer to astronomy

Students are invited to submit original crossword puzzles for publication in *Senior Science*. Each puzzle should be built around one topic in science, such as astronomy, astronautics, botany, geology, electronics, famous scientists, etc. Maximum of 50 words, of which at least 15 must be related to the theme. For each puzzle published we will pay $10. No entry will be considered unless it includes all of the following: symmetrical puzzle design and design with answers filled in, definitions, answers on separate sheets, and a statement by the student that the puzzle is original and his own work. **Puzzles must be symmetrical.** Keep a copy, as puzzles cannot be returned. Give name, home address, school, and grade. Address: Puzzle Editor, *Senior Science*, 50 West 44th Street, New York, N. Y. 10036. Answers to this puzzle are on page PAGE 20

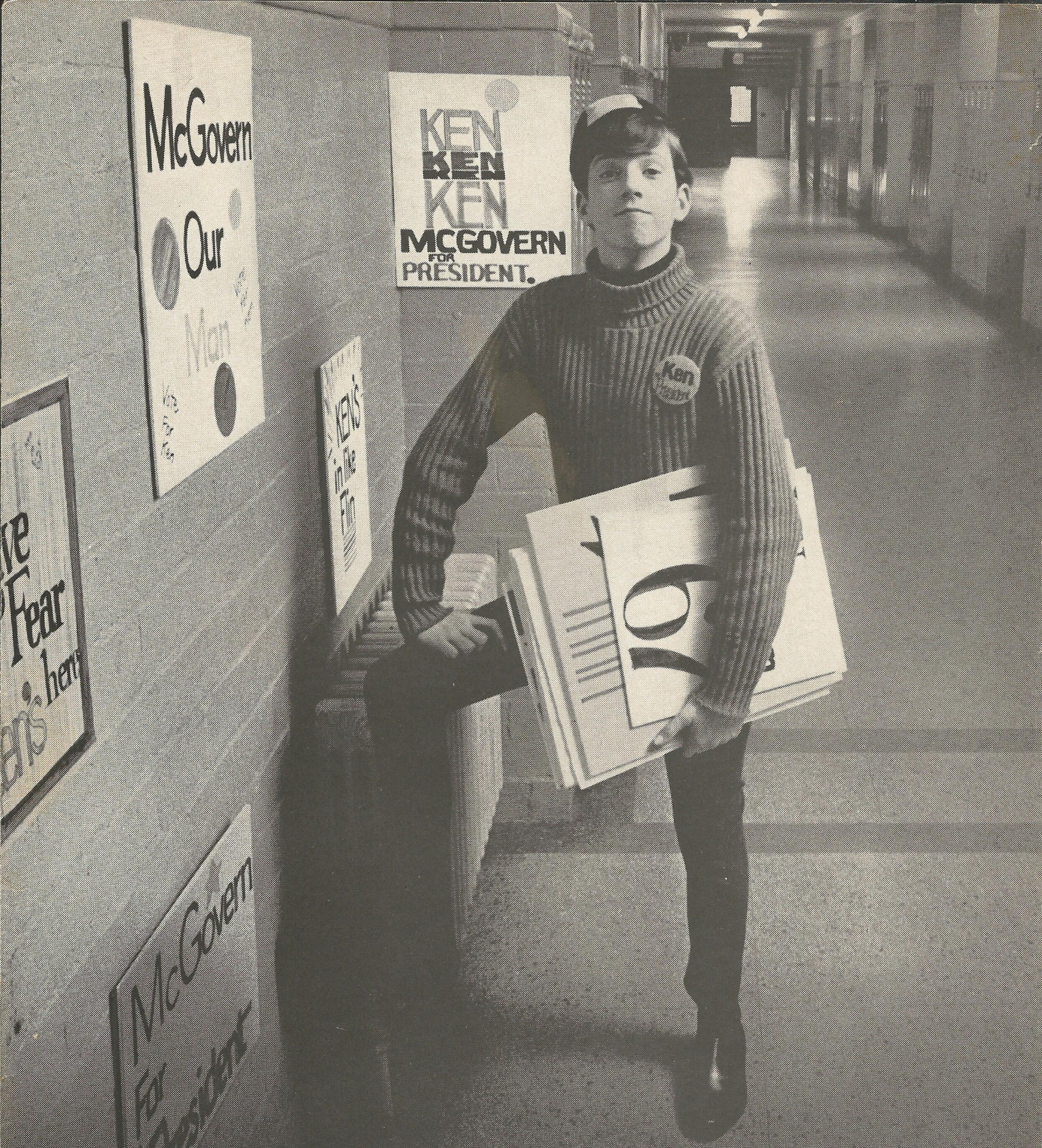


ACROSS

* 1. Point closest to sun.
10. Medieval weapon.
11. Travelers' way station.
13. Article.
15. Homonyn of "sew."
16. Type of fish.
*17. A satellite of Jupiter.
*18. Closest star.
*20. Sun directly overhead.
22. Faucet.
*23. Sun is one.
25. Ate *(colloq.)*.
*26. Month in which the shortest day occurs.
27. Roll.
29. A religious.
30. River in USSR.
32. Exist.
33. Out *(antonym)*.
34. Not off.
35. Compassion.
37. An interjection.
39. Prefix meaning "all."
*41. Type of tide.
42. Ears do it.
44. Bag-like part of an animal.
45. Form of "to be."
46. Bone meal is rich in this element *(abbr.)*.
47. ___open: recommence.
49. Greek letter.
50. African river.
52. Dine.
*54. Orbital motion.

DOWN

2. Printer's measure.
3. Ethiopian title of nobility.
4. Image.
* 5. Element No. 2 *(chem. sym.)*.
* 6. Leo is one.
7. Hoosier state *(abbr.)*.
8. Every night *(Lat. abbr.)*.
* 9. "Seated" constellation.
*12. Conceived heliocentric theory.
14. Cashew is one.
16. Small bed.
17. An Englishman's name.
19. Grab.
21. A classical diphthong.
22. Cask for wine.
*24. Crystal used in laser.
*26. A planetoid.
28. A compass point.
29. Element used in American coinage *(abbr.)*.
31. Articles of children's wear.
34. South American linguistic family.
36. Consumption's modern name *(abbr.)*.
37. This man.
38. Rower's tool.
40. A handwritten work *(abbr.)*.
*42. Ring around the moon.
43. Relaxation.
46. 104 *(Roman)*.
48. Yes *(Fr.)*.
*50. Gas used in making lamps *(chem. sym.)*.
51. Elevated railway.
53. It. river.



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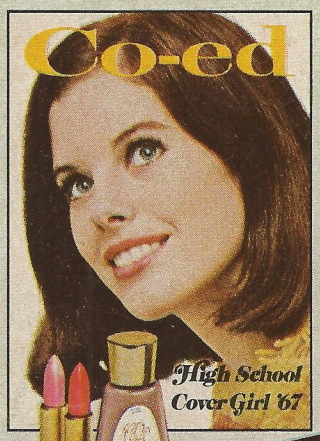

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